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BASIC PESTICIDE TRAINING MANUAL

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MONTANA DEPARTMENT OF AGRICULTURE
ENVIRONMENTAL MANAGEMENT DIVISION
DECEMBER, 1985
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PREFACE

This manual was prepared primarily as a study guide for all applicators and dealers being licensed to sell or apply general or restricted use pesticides. The manual provides basic information concerning laws regulating pesticide use, potential hazards to humans and the environment, safe use, first aid, and alternatives to pesticides. The manual provides the general information that, coupled with applicators' experience, can allow for safer, more discriminate use of pesticides.

The Basic Pesticide Manual can also serve as a reference source for applicators, dealers, and other interested persons. Because of the complex nature of the subject of pesticides and pest control, many specific problems cannot be addressed. For help with these, applicators are encouraged to contact the Montana Department of Agriculture or their County Extension Agent.

To simplify information, trade named products and equipment have been mentioned. No endorsement is intended, nor is criticism implied of similar products or equipment which are not mentioned.

We wish to acknowledge the personnel of the Environmental Management Division, Montana Department of Agriculture, for their help in preparing this manual.

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CHAPTER I

FEDERAL PESTICIDE LEGISLATION

A. ENVIRONMENTAL PROTECTION AGENCY

The history of federal legislation on pesticide control begins with the Insecticide Act of 1910 which regulated only insecticides and fungicides. Regulations governing the use of pesticides on food were included in the 1906 Pure Food Law in 1938. The 1910 Insecticide Act was replaced and expanded by the Federal Insecticide, Fungicide and Rodenticide Act of 1947 (FIFRA). This Act required that all pesticides moving in interstate commerce be registered by the USDA and be safe for use. The manufacturer was required to label his product with instructions for proper use and for the public's protection. From 1950-1970, several pieces of legislation, dealing primarily with packing and safety regulations, were added to FIFRA. Since August of 1975, FIFRA has also regulated all pesticides manufactured and used within a state.

The federal responsibility for regulating pesticides was transferred to the Environmental Protection Agency (EPA) in 1970. The principal authority given to the agency in controlling pesticides is contained in the Federal Insecticides, Fungicide and Rodenticide Act (FIFRA), as amended in 1972. FIFRA, as amended, empowers EPA to register and inspect pesticide producing establishments and certify applicators where pesticides have been designated for restricted use. The 1972 law extended federal registration and regulation to all pesticides including those distributed or used within a single state. FIFRA was again amended in 1978. The following pages summarize some of the more important provisions of the FIFRA, as amended.

1. Registration

The distribution, sale, offering or holding for sale, shipment, delivery, or receipt within any state of any pesticide which is not registered with the EPA is prohibited. Registration is the procedure whereby the applicant files a statement that includes a copy of the labeling, the claims to be made for the pesticide, directions for its use, and the complete formula of the pesticide.

EPA has the authority to cancel a pesticide registration if it is later determined that the directed use of the pesticide poses a serious hazard to man or the environment. A registrant can appeal an EPA cancellation notice through a process of public hearings and review by a scientific advisory group. Suspension of pesticide registration, unlike cancellation, stops interstate shipments immediately, but can be initiated only when the product presents an imminent danger. The EPA Administrator may issue a "stop sale, use and removal" order when it appears that a pesticide violates the law or its registration has been suspended or finally cancelled.

FIFRA, as amended, requires the registration of all pesticide producing establishments. Information as to the types and amounts of pesticides produced, distributed, and sold must be submitted upon registration of the firm and annually thereafter.

2. Classification of Pesticides

The 1972 amendments required that all pesticides must be classified for general or restricted use by 1972 but an extension for classification was granted until 1977. In 1980, the initial classification of all pesticide products had not been accomplished and was expected to take several years more.

> a. A "general use" pesticide is defined in FIFRA as one which "will not generally cause unreasonable adverse effects on the environment" when used in accordance with its labeling or widespread and commonly recognized practices. Such pesticides normally will be available to the public. A "restricted use" pesticide is defined as one which "may generally cause unreasonable adverse effects on the environment, including injury to the applicator" unless it is subject to additional regulatory restrictions beyond labeling.
>
> Those pesticides placed in the restricted category may be used only by or under the supervision of certified applicators or under such other conditions as the EPA Administrator may require to protect man and the environment. If the Administrator determines that some of the uses for which a pesticide is registered should be general use and that other uses for which it is registered should be restricted use, he shall classify it for both general and restricted use. It is essential, however, that the directions relating to its general uses shall be clearly separated and distinguished from those directions relating to its restricted uses.

3. Certification of Pesticide Applicators

The 1972 amendment defines two classes of applicators and directs the Administrator to establish separate standards for commercial and private applicators. The term "private applicator" is defined in the Act as a certified applicator who uses or supervises the use of any "restricted use" pesticide for the purpose of producing any agricultural commodity on property owned or rented by him or his employer. However, Montana regulations allow the application of a restricted pesticide on property of an immediate or adjacent landowner, if applied without compensation other than trading of personal services between producers.

The term "commercial applicator" is defined in the Act as a certified applicator (whether or not he is a private applicator) who uses or supervises the use of any "restricted use" pesticide for any purpose or on property other than as provided by the definition of "private applicator". Certified applicator may be classified in one or more categories.

4. Certification Standards for Commercial Applicators

All commercial applicators shall demonstrate practical knowledge of the principles and practices of pest control and safe use of pesticides. Written testing shall be based on examples of problems and situations appropriate to the particular category or subcategory of the applicator's certification. Areas in which a commercial applicator must prove to be competent include: label comprehension, safety practices, environmental concerns, pest identification and biology, pesticides and proper application techniques, types of equipment, and laws and regulations governing pesticide sales and use. Once certified, a commercial applicator's license must be renewed annually.

5. Specific Standards of Competency for Each Category of Commercial Applicators

Certain of the above factors are of particular importance because of the types of activities carried out by applicators in different categories. Such factors must be especially stressed and specifically reflected in state certification standards. For example, practical knowledge of drift problems should be required of agricultural applicators but not of seed treatment applicators. The latter, however, should be particularly knowledgeable of the hazards of the misuse of treated seed and necessary precautions. Accordingly, commercial applicators in each category shall be qualified with respect to the standards in their categories:

a. Agricultural Pest Control

(1) Plant

Applicators must demonstrate practical knowledge of the specific pests of crops on which they may use restricted use pesticides. The importance of such competency is amplified by the extensive acreages involved, the quantities of pesticides needed, the ultimate use of many commodities for human and animal food. Practical knowledge is required concerning soil and water contamination, preharvest intervals, re-entry intervals, phytotoxicity, potential for environmental contamination, non-target injury, and problems resulting from the use of restricted use pesticides near communities.

(2) Animal

Applicators applying pesticides directly to animals must demonstrate practical knowledge of such animals and their associated pests. A practical knowledge is also required concerning specific pesticide toxicity to humans since treated animals will frequently be used for food. Further, the applicator must know the hazards associated with such factors as formulation, applicator techniques, age of animals, stress, and extent of treatment.

(3) Vertebrate

This category includes any applicator using or supervising the use of pesticides in the management of vertebrate animals, including wild predators, rodents, and birds, which may adversely affect man's health or property or are a nuisance to man.

b. Regulatory Pest Control

This category includes state, federal or other governmental employees who use or supervise the use of pesticides in the control of regulated pests. The following category of government applicators are established to more accurately reflect specific duties and areas of operation: Mosquito abatement, predator, quarantine, rabid skunk, rodent and weed.

Applicators shall demonstrate practical knowledge of regulated pests, applicable laws relating to quarantine and other regulation of pests, and the potential impact on the environment of restricted use pesticides used in suppression and eradication programs. They shall demonstrate knowledge of factors influencing introduction, spread, and population dynamics of relevant pests. Their knowledge shall extend beyond that required by their immediate duties since their services are frequently required in other areas where emergency measures are invoked to control regulated pests and where individual judgments must be made in new situations.

c. Forest Pest Control

This category includes any applicator using or supervising the use of pesticides in forests, forest nurseries, and forest seed producing areas.

Applicators shall demonstrate practical knowledge of the types of forests, forest nurseries, seed production and pests involved. They should possess practical knowledge of pest population cycles and yearly life cycles as a basis for programming pesticide applications. A practical knowledge is required of non-target organisms and their vulnerability to pesticides to be applied. Because forest stands may be large and include natural aquatic habitats and wildlife, the consequences of pesticide use may be difficult to assess. The applicator must therefore demonstrate practical knowledge of methods which will minimize the possibility of secondary problems such as unintended effects on wildlife. Proper use of specialized equipment must be demonstrated, especially as it may relate to weather conditions and adjacent land use.

d. Ornamental and Turf Pest Control

This category includes any applicator using or supervising the use of pesticides in the maintenance and production of ornamental trees, shrubs, flowers, and turf.

e. Seed Treatment

This category includes any applicator using or supervising the use of pesticides on seeds.

Applicators shall demonstrate practical knowledge of types of seeds that require chemical protection against pests and factors such as seed coloration, carriers, and surface-active agents which influence pesticide binding and may affect germination. They must demonstrate practical knowledge of hazards associated with handling, sorting and mixing, proper disposal, and misuse such as the introduction of treated seed into food. They must demonstrate proper handling of grain fumigants.

f. Aquatic

This category includes commercial applicators using or supervising the use of any restricted use pesticide purposefully applied to standing or running waters, excluding applicators engaged in public health related activities.

Applicants shall demonstrate practical knowledge of water use, aquatic pesticides, aquatic pests and the potential of downstream effects.

g. Right-of-Way Pest Control

This category includes any applicator using or supervising the use of pesticides in the maintenance of public roads, electric power lines, pipelines, railway right-of-ways, or other similar areas.

Applicators shall demonstrate practical knowledge of a wide variety of environments since right-of-ways can traverse many different terrains, including waterways.

They shall demonstrate practical knowledge of problems of runoff, drift, and excessive foliage destruction and ability to recognize target organisms. They shall also demonstrate practical knowledge of the nature of herbicides and the need for containment of these pesticides within the right-of-way area, and the impact of their application activities on the adjacent areas and communities.

h. Industrial, Institutional, Structural, and Health Related Pest Control

This category includes any applicator using or supervising the use of pesticides in, on, or around food handling establishments, human dwellings, institutions such as schools, hospitals, industrial establishments including warehouses and any other structures and adjacent areas, public or private, and for the protection of stored, processed, or manufactured products.

Applicators must demonstrate a practical knowledge of a wide variety of pests including their life cycles, as well as types of formulations appropriate for their control, and methods of application that avoid contamination of food, damage and contamination of habitation, and exposure of people and pets. Since human exposure is a potential problem, applicators must demonstrate practical knowledge of the specific factors which may lead to a hazardous condition such as continuous exposure to a pesticide. Because health related pest control may involve outdoor applications, applicators must also demonstrate practical knowledge of environmental conditions related to this activity.

i. Public Health Pest Control

This category includes state, federal, or other governmental employees using or supervising the use of pesticides in public health programs for the management and control of pests having medical and public health importance. The jurisdictional health officer, state veterinarian, their duly authorized representatives, and governmental research personnel are exempt from licensing when applying general use pesticides to experimental areas.

Applicators shall demonstrate practical knowledge of vector-disease transmission by pests. A wide variety of pests are involved and it is essential that they can be recognized and appropriate life cycles and habitats be understood as a basis for control strategy. These applicators shall have practical knowledge of a great variety of environments ranging from streams to buildings. They should also have practical knowledge of the importance and employment of such non-chemical control methods as sanitation, water disposal, and drainage.

j. Demonstration and Research Pest Control

This category includes: 1) individuals who demonstrate to the public the proper use and technique of application of restricted pesticides or supervise such demonstrations, and 2) individuals conducting field research with pesticides and in doing so, use or supervise the use of restricted use pesticides. Included in the first group are such individuals as Extension Specialists and County Agents, Commercial Representatives demonstrating pesticide products, and those individuals demonstrating methods used in public programs. The second group includes state, federal, commercial, and other individuals conducting field research on or utilizing pesticides.

Since persons in this category are involved in demonstrating the safe and effective use of pesticides to other applicators and the public, they will be expected to meet inclusive standards as evidenced by satisfying especially rigorous examinations. Many different pest problems will be encountered in the course of activities associated with demonstration, and practical knowledge of problems, pests, and population levels occurring in each demonstration situation is required. Further, they should demonstrate an understanding of pesticide-organism interactions and the importance of integrating pesticide use with other control methods. In general, it would be expected that applicators in this category would possess a practical knowledge of all of the standards detailed in Section 4, page 3. In addition, they shall meet the specific standards required for categories 5a through j as may be applicable to their particular activity.

6. Certification Standards for Private Applicators

Private applicators wishing to purchase and apply restricted use pesticides must first become certified. Certification may be achieved by: 1) attending a pesticide training course and completing a quiz at the end of that training course, and 2) by taking the Private Applicators Exam without the benefit of the pesticide training course. A score of at least 70% is required for certification.

7. State Certification Procedures

States are expected to develop and administer applicator certification procedures based on standards of competence which meet or exceed those prescribed by the Administrator of the EPA. The State of Montana certification program was approved by EPA in 1976.

8. Penalties

Section 14 of FIFRA provides for criminal and civil penalties to be assessed for violations of provisions of the Act. Civil penalties are more in the nature of a fine and may be imposed by EPA on those persons and/or companies who violate portions of the Act. Any manufacturer, commercial applicator, or distributor may be fined up to $5,000 for each offense. Private applicators or others who are not employed in pesticides commercially will usually be given a written warning and/or a fine of up to $500 for the first offense. However, on subsequent offenses, a private applicator may be fined up to $1,000. Fines for civil offenses may be determined and imposed by the Regional EPA Administrator.

No person will be assessed a civil penalty until he has an opportunity for a hearing in the county or incorporated city of his residence. If the person believes he is being forced into accepting an unfair decision from the federal agency, he may appeal to the courts.

Criminal penalties are more serious violations of the law and are usually decided in courts. Persons or companies and private applicators who knowingly violate the provisions of the Act may be found guilty of misdemeanors. In this case, the key phrase is "knowingly violates".

Conviction of companies or commercial persons under this category will be subject to a fine of up to $25,000 or one year in prison, or both. Private applicators who are found guilty of misdemeanors under this portion of the law may be fined up to $1,000 or imprisoned for 30 days, or both.

If the Administrator is unable to collect the fine levied in civil penalty, he may turn the case over to the U.S. Attorney General who can then take the case to the U.S. District Court.

CHAPTER II

STATE PESTICIDE LEGISLATION

A. MONTANA DEPARTMENT OF AGRICULTURE

In 1947, Montana adopted its first pesticide act, entitled the "1947 Insecticide, Fungicide and Rodenticide Act". This Act was administered by the Department of Health and required registration of all economic poisons (pesticides) in Montana. This Act was repealed July 1, 1971.

Montana Pesticides Act

The Montana Pesticides Act, Title 80, Chapter 8, Sections 80-8-101 through 80-8-306, MCA, enacted by the 43rd Legislature in 1971, is administered by the Department of Agriculture.

This Act is comprehensive in its regulation of the sale and use of pesticides. The Act may be subdivided into three major areas of responsibility: registration of pesticides; licensing of pesticide applicators, operators, and dealers; and enforcement and administrative procedures.

1. Registration of Pesticides

Every pesticide must be registered with the Montana Department of Agriculture before it may be legally offered for sale or used in this state. This includes all different labels and formulations of a particular active ingredient. Registration of each product remains the responsibility of the manufacturer. The annual registration fee is $50 per pesticide registered. All registrations expire on December 31, following date of issuance, unless otherwise terminated. Pesticides registered by the Federal government _must_ be registered by Montana. However, the state may restrict their use and application to type of applicators, time and place. The department may suspend or cancel the registration of a pesticide whenever it does not appear that the article or its labeling comply with the Act or whenever scientific evidence proves that the article endangers man or the general environment. Montana also registers pesticides formulated within the state.

The Department of Agriculture is given the authority to sample, inspect, and make analysis of pesticides distributed within this state to determine whether such pesticides are in compliance with this Act. Pesticides not in compliance may be embargoed; if they are:

(1) adulterated or misbranded,
(2) not registered,
(3) fail to bear a proper label, or
(4) a white powder pesticide and not colored as required.

Pesticides embargoed cannot be removed, disposed of or sold until the Department's agent or the court gives permission. Articles embargoed may be brought into compliance with the law, at which time the embargo is removed. If the product cannot meet the provisions of the Act, it is disposed of at the expense of the claimant.

2. Special Registrations

The Department may also register pesticides under Section 24(c) and Section 18 of FIFRA. Section 24(c) (Special Local Need) and Section 18 (Specific or Emergency Exemption) registrations generally require supplemental labeling. It is the responsibility of the dealer to make sure that this labeling accompanies the product when sold, and it is the responsibility of the applicator to have this labeling in his possession when the product is applied.

Refer to Sections 80-8-201 through 80-8-202 of the Act for more detailed information concerning registration of pesticides.

3. Licensing Provisions

a. Commercial Applicators

Commercial applicators are individuals who operate and have a financial interest in a pesticide application business. Individuals not having a financial interest in the business and who are only responsible for the daily mechanical operation of pesticide application equipment are not classified as commercial applicators.

A license for commercial applicators is required annually and MUST be renewed each calendar year before applying pesticides. Before granting a license, the Department requires each applicant to pass an examination and pay a licensing fee of thirty five dollars ($35).

All license holders must be recertified periodically, according to a pre-determined schedule produced by the Montana Department of Agriculture. Contact the Environmental Management Division or Area Pesticide Specialist for further information.

Applicants for a commercial pesticide applicators license shall be required to provide, on forms approved by the Department, financial responsibility in the form of a liability insurance policy, surety bond, or cash in escrow. For application of general or restricted use pesticides, the financial responsibility shall be one thousand five hundred dollars($1500) for aerial applicators and five hundred dollars ($500) for ground applicators. Financial responsibility shall be maintained throughout the licensing period. Aerial applicators must also meet all the requirements of the Federal Aviation Agency and Montana Aeronautics Commission before a license is issued. Applicators obtaining a dealers license must pay an additional twenty dollar ($20) licensing fee.

Commercial applicators are responsible for all actions carried out by their employees (commercial operators) when the employee is working for the applicator. The Department of Agriculture may also establish licensing and examination requirements for commercial operators by regulation.

b. Dealer

The Montana Pesticides Act requires that all pesticide dealer outlets be licensed to sell pesticides in Montana. Pesticide salesmen and fieldmen not under the supervision of a dealer must also be licensed. To become licensed, dealers must submit an application to the Department of Agriculture with a thirty five dollars ($35) licensing fee each calendar year. If any pesticides are sold by the dealer or his employees before licensing, he will be in violation of the Montana Pesticide Act. Dealers are also required to pass an examination before a license is granted.

c. Retail Noncommercial Sale of Pesticides

Retailers may only sell pesticides which are designated for use for home, yard, garden, and lawns. The Department of Agriculture may also limit the retail sale of such pesticides to quantities up to a specific number of pound(s) or gallon(s) and of such concentration as should be sublethal to humans and animals.

d. Farm Applicators

The Department of Agriculture is authorized by the regulations governing the Montana Pesticides Act to designate restricted use pesticides for agricultural use. Pesticides so restricted cannot be purchased and/or utilized by farm applicators (private applicators under FIFRA) on commercial crops, land, or livestock unless they obtain a special use permit. To obtain a permit, farm applicators must pass a Farm Applicator Exam or attend a training course and complete an ungraded quiz. A farm applicator does not require a permit or a commercial applicator license when he:

(1) applies general use pesticides to his own land,
(2) is not engaged in the business of applying pesticides for hire, and
(3) operates his equipment only in the vicinity of his own property and for the accommodation of his immediate neighbors.

The special use permit is issued for 5 calendar years and the fee for the permit is fifteen dollars ($15).

e. Non-Residents

Non-residents applying for a license in Montana must file a written power of attorney designating the Secretary of State as their agent upon whom service of process may be had in event of any suit, ordering effective the jurisdiction of the courts in Montana. Non-resident corporations in lieu of appointing the Secretary of State may appoint a resident agent.

f. Revocation of License

The Department of Agriculture may refuse to grant, renew, or may revoke a license or permit when the Department is satisfied that the licensee or holder of the permit is not qualified to sell, use, or apply pesticide or he has committed any of the following:

(1) Made false or fraudulent claims, misrepresenting the effect of materials or methods to be utilized.

(2) Applied illegal materials.

(3) Operated in a faulty or careless or negligent manner.

(4) Operated faulty or unsafe equipment.

(5) Refused or neglected to comply with provisions of this Act.

(6) Used or applied a registered pesticide inconsistent with its label or labeling.

(7) Refused or neglected to keep and maintain application records.

(8) Made false or fraudulent records or reports.

(9) Operated equipment without a permit or license.

(10) Used fraud or misrepresentation in making application for license or permit or renewal of a license or a permit.

Decisions of the Department relating to issuing or revoking licenses or permits may be appealed.

g. Government Agencies

Government employees applying pesticides are subject to the provisions of this Act and regulations adopted thereunder. Supervisors of pesticide spray programs will be required to obtain a limited commercial applicators license. All applicants for this license will be required to pass an examination. The annual license fee for government applicators or dealers is fifty dollars ($50). A provision allows a governmental agency to pay the annual applicator's fee of fifty dollars ($50) for each of its first four employee applicators. The agency shall then pay an annual fee of five dollars ($5) for each additional employee applicator. The limited license can only be used when the applicant is applying pesticides for the Agency. One licensed applicator or licensed operator is required for each pesticide equipment unit operated by government agencies.

h. Report of Loss or Damage

Any person may report losses or damages to the Department of Agriculture. Refer to Section 80-8-301 of the Act for full description or requirements.

4. Administrative Procedures

a. Rules and Regulations

The Department of Agriculture has the authority to adopt by reference without a public hearing, regulations adopted under the Federal Insecticide, Fungicide and Rodenticide Act; or after public hearing, to adopt rules and regulations necessary to carry out the provisions of this Act.

b. Emergency Power

The Department of Agriculture may declare an emergency when an event exists which requires immediate action with regard to the registration, use or application of pesticides. The director may, without notice or hearing, issue necessary orders to protect the public from adverse affects of pesticides. The emergency period may not exceed the time prescribed by the Administrative Procedure Act. However, in this period of time, a regulation may be passed to control the pesticide following the emergency period.

c. Public Hearings

The Department of Agriculture must hold public hearing when adopting new rules and regulations, except when adopting federal regulations. Specific procedures for rulemaking and hearing functions shall be conducted in accordance with the Administrative Procedure Act.

d. Public Information

The Department may publish or make available information on the registration, use and sale of pesticides in Montana, provided that this information will NOT disclose such operations as selling, production or use of pesticides by any person.

e. The Department of Agriculture or its duly authorized agents, upon reasonable cause, shall have the authority to enter upon private and public premises and property at reasonable times with a warrant or consent of the inhabitant or owner to inspect or investigate:

(1) Equipment subject to this Act,

(2) Actual or reported adverse effects caused by pesticides in humans, crops, animals, land or other property,

(3) Records on the selling or use of pesticides and the person's stock of pesticides,

(4) Storage and disposal of pesticides by persons licensed or regulated under the chapter,

(5) Sample pesticides being applied or to be applied, or

(6) The use and application of a pesticide.

f. Violation

Any person convicted of violating provisions of the Act or regulations issued thereunder shall be adjudged guilty of a misdemeanor. Temporary and permanent injunctions may be obtained under the Act to restrain individuals from violating or continuing to violate any provisions of the Act.

B. MONTANA DEPARTMENT OF HEALTH AND ENVIRONMENTAL SCIENCE

There are several laws administered by the Department of Health and Environmental Sciences which establish pesticide tolerance levels in foods, proper disposal methods of excess pesticide materials and empty pesticide containers. These laws are as follows:

1. Montana Food, Drug and Cosmetic Title 50 - Chapter 31, MCA

The Montana Food, Drug and Cosmetic Act (MFDCA) has been revised numerous times since it was adopted in 1911. Two important amendments to MFDCA are:

a. The Miller Amendment of 1954 which provides that any raw agricultural commodity be condemned as adulterated if it contains pesticides for which no tolerance is established or for which established tolerance limits are exceeded.

b. The Delaney Clause which prohibits the introduction of cancer causing substances in food.

2. Water Quality Act, Title 75 - Chapter 5, MCA

This Act makes it unlawful to pollute any state waters, or to place or cause to be placed any wastes, in a location where they are likely to cause pollution of state waters.

State water is defined as "any body of water, irrigation system, or drainage system either surface or underground; this shall not apply to irrigation waters where the waters are used up within the irrigation system and the waters are not returned to any other state waters."

Wastes are defined as "sewage, industrial and other waste." Industrial waste means "any waste substance from the process of business or industry, or from the development of any natural resource together with any sewage that may be present." Other wastes means "garbage, municipal refuse, decayed wood, sawdust, shavings, bark, lime, sand, ashes, offal, night soil, oil, tar, chemicals, dead animals, sediment, and all other substances that may pollute state waters."

a. Water Quality Standards

Water Quality Standards classifying and describing all state waters and establishing general and specific water quality criteria have been developed and adopted by the Department. The specific water quality criteria, in part, set allowable concentrations of toxic or other deleterious substances, pesticides, and organic and inorganic materials for each water-use, class. General water quality criteria apply to all state waters.

b. General Criteria Relating to Pesticides

(1) "State surface waters are to be free from substances attributable to municipal, industrial, agricultural practices or other discharges that will:

(a) Produce odors, colors or other conditions as to create a nuisance or render undesirable tastes to fish fleshor make fish inedible.

(b) Create concentrations or combinations of materials which are toxic or harmful to humans, animal, plant, or aquatic life."

(2) "No wastes are to be discharged and no activities conducted that the wastes or activities will violate, or can reasonably be expected to violate, any of the standards."

(3) "Application of pesticides in or adjacent to state waters are to be in compliance with the labeled directions, and in accordance with provisions of the Montana Pesticide Act (Title 80, Chapter 8, MCA) and the Federal Environmental Pesticides Act (Public Law 92-516). Excess pesticides and pesticide containers are not to be disposed of in a manner or in a location where they are likely to pollute state waters."

(4) "A person who violates any rule, permit, effluent standard, or order issued pursuant to the provisions of this Act shall be guilty of an offense and subject to a civil penalty not to exceed ten thousand dollars ($10,000). Each day of violation constitutes a separate offense."

(5) "Any person who willfully violates 75-5-605 is guilty of an offense and subject to a fine not to exceed twenty five thousand dollars ($25,000) per day of violation or by imprisonment for not more than one year or both."

3. Montana Solid Waste Laws

The Montana Solid Waste Management Act prohibits the disposal of any solid waste in any location not licensed as a solid waste disposal site by the State Department of Environmental Sciences. Refuse is defined as "all putrescible and nonputrescible solid industrial wastes." In this context, some pesticides are included within the definition. Any person found violating this act is guilty of a misdemeanor.

Please refer to "A Guide to Pesticide Disposal for Commercial and Government Applicators in Montana," available from the Montana Department of Agriculture or the Montana Department of Health and Environmental Sciences, for additional information.

4. Occupational Health, Title 50 - Chapter 7, MCA

The Occupational Health Law gives all persons and employees the right to working conditions which will protect human health and safety. This Act does not allow airborne contaminates (including pesticides) to exceed Established Threshold Limit Values adopted by the State Board of Health.

CHAPTER III

PESTICIDE LABELING GUIDELINES

The pesticide label is the final result of a registration process and reflects the risks and benefits of a given pesticide to the user. Industry spends from 20 million dollars on research to develop a label for a single 30 to 40 pesticide product before that product is ever marketed. Due to this expense, industry has called for tighter controls on the distribution, sale, and use of their products to insure their continued use. The result has been the marketing of pesticides that have labels with specific instructions in terms of safety, storage, disposal, and use.

The Federal Insecticide, Fungicide and Rodenticide Act requires specific information to be printed on the container labels of registered pesticides. This provision is made for the protection of humans, animals, plants, and the environment.

The importance of reading the label cannot be overstressed. Labels are placed on pesticide containers for your information and protection. If the label is read, studied, and understood prior to purchase or use of a pesticide, the possibility of a pesticide accident occurring is minimized. The label is your "Prescription for Use."

A. FORMAT LABELS

The Section 3 Regulations governing FIFRA require that certain statements appear at specific locations on a pesticide label. This concept of a format label for all pesticide products was initiated to provide ready access to specific information and to increase the understanding of the proper use of pesticides. Figure 1 and 2 show the locations of required statements on a pesticide label.

NOTE: The primary difference between the General Use and Restricted Use Pesticide labels is the presence of the "Restricted Use Pesticide" block at the top of the center panel. Use of products with a restricted use label requires certification of both private and commercial applicators.

Figure 1. General Use Pesticide Label

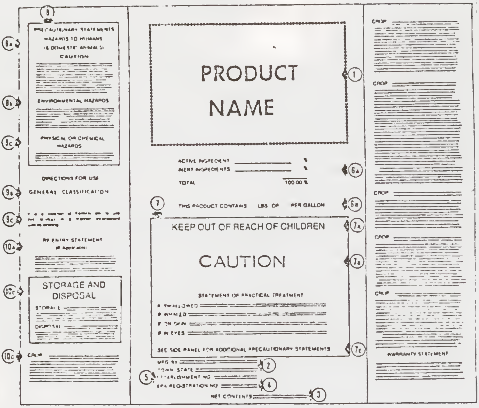
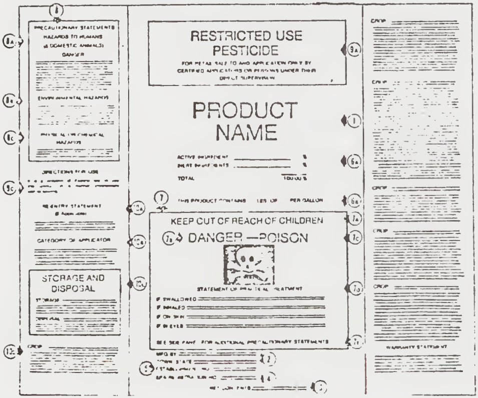


Figure 2. Restricted Use Pesticide Label



B. BASIC LABEL REQUIREMENTS

Refer to Figures 1 and 2 for the physical location of basic label requirements. The label requirements are numbered from 1 to 10 on each figure.

1. Product Name

The name used on the container must not be misleading in any respect regarding its composition, usefulness, or safety. Examples: 2,4-D Low Vol Ester, Carbyne.

2. Company Name and Address

The name and address of the manufacturer, registrant, or person or firm registering the product must appear on the label. Example: Velsicol Chemical Corporation, 321 East Ohio Street, Chicago, IL 60611. If the registrant is other than the manufacturer, the label should indicate both parties.

3. Net Contents

All labels must bear a statement of the net weight or measure of the content. If the product is a liquid, a solid, a semisolid, or a mixture of solid and liquid, the contents must be stated in terms of weight.

4. EPA Registration Number

All labels must bear the registration number assigned to the product. The number must be preceded by the phrase "EPA Registration No." or "EPA Reg. No." This number will identify both the registrant and the product. Example: 876-45-AA. This identifies Velsicol as the Registrant and the product as MonDak Herbicide.

5. EPA Establishment Number

The EPA Establishment Number must appear on all labels and will identify the actual establishment that formulated the product and the location of that establishment by state. Example: EPA Est. No. 876-TX2. This identifies Velsicol as the establishment, located in Texas, and it is one of 2 formulating plants in that state operated by Velsicol.

6. Ingredient Statement

a. The ingredient statement must appear on all labels and must include the generic chemical name, the percentage of each active ingredient and the total percentage of the inert ingredients. Example: Tordon Label

Active Ingredients:

Picloram (4-amino-3,5,6-trichloropicolinic acid) as the potassium salt
- - - - - - - - - - - - - - - - 24.9%

Inert Ingredients - - - - - - 75.1%

b. Pound per gallon statement will appear directly below the main ingredient statement when the dosage of a liquid product is given as pounds of active ingredient per unit area. Example: Tordon Label

Acid Equivalent:

4-amino-3,5,6-trichloropicolinic
acid 21% ------- 2 lb.gal.

7. Front Panel Precautionary Statements

All front panel precautionary statements must be grouped together and they include:

a. KEEP OUT OF THE REACH OF CHILDREN

This statement must appear on all pesticide products regardless of classification or toxicity.

b. Signal Work

Pesticides are classified into four broad categories of toxicity. Specific signal words give an indication of the toxicity of that product to man.

(1) A category I product is identified by the signal word "DANGER." These pesticides can cause toxic effects on contact with the skin and can be extremely corrosive to skin and eyes. As Table 1 indicates, category I pesticides are the most toxic if swallowed. It takes just a taste to a teaspoonful of most category I products to be lethal. Example : Parathion

(2) A category II pesticide is identified by the signal word "WARNING." A lethal dose is approximately a teaspoon to a tablespoon of a pesticide. Example: Diazinon

(3) A category III pesticide is identified by the signal word "CAUTION." A lethal oral dose is one tablespoon to a pint. Example: Tordon

(4) A category IV pesticide has no signal word and is relatively non-toxic unless consumed in copious amounts. Example: Household cleansers

Table 1. Toxicity Categories for Labeling Pesticides

Category	Signal Word Label	LD_{50} for 150 lb. Human		Oral LD_{50} in Common Measuring Units
		Oral LD_{50} (mg/kg)	Dermal LD_{50} (mg/kg)	
I	Danger ✓	0 - 50	0 - 200	Taste-teaspoon
II	Warning ✓	50 - 500	200 - 2000	Tsp-tablespoon
III	Caution	500 - 5000	2000 - 20,000	1 oz. - pint
IV	None	Over 5,000	Over 20,000	Over pint

* LD_{50} is the amount of pesticide, measured in milligrams per kilogram of body weight, that will kill one-half of the exposed population.

c. Additional Signal Statement

If a pesticide was assigned to category I on the basis of its oral, dermal, or inhalation toxicity, the word "Poison" and the skull and crossbones must appear in close proximity to the signal word.

d. Statement of Practical Treatment

For a category I product, the statement of practical treatment must appear on the front panel. For all other categories, it may appear on the side panel. This statement details emergency first-aid treatments in the event of a pesticide accident as well as specific instructions for physicians.

e. Referral Statement

This statement must appear on those products upon which the precautionary labeling appears on other than the front panel.

8. Side/Back Panel Precautionary Statements

This precautionary statement must include the statements of Practical Treatment (when not on the front panel), Hazards to Humans and Domestic Animals (8a), Environmental Hazards

(8b) (includes the bee caution when applicable), and Physical or Chemical Hazards (8c).

9. Restricted and General Use Statements and Misuse Statement

a. Restricted Use Statement

Pesticides classified for restricted use shall have the statement "Restricted Use Pesticide" placed prominently at the top of the front label. A product so designated can only be purchased and/or used by a certified applicator.

b. General Use Statement

Pesticides classified for general use must be labeled with the words "General Classification" immediately below the heading "Directions for Use".

c. Misuse Statement

The misuse statement must appear on all products and state, in general terms, that it is a violation of Federal Law to use the product in a manner inconsistent with the label.

10. Statements Concerning Re-entry, Applicator Category, Storage and Disposal, and Directions for Use

a. Re-entry

The re-entry statement must appear on all products that are cholinesterase inhibitors. This statement tells an individual when it is safe to enter a treated area without the use of protective equipment.

b. Category of Applicator Statement

A statement restricting the use of a product to a particular category of applicator may appear on various products. Example: Diazinon 4S - For Use by Pest Control Operators Only. All Restricted Use Pesticides will indicate that use of that product is by certified applicators only.

c. Storage and Disposal Statement

The storage and disposal statement must appear on all pesticide products. It may contain very specific storage and/or disposal instructions. Example: Roundup - store above 10 degrees F to Keep From Freezing.

d. Directions for Use Statement

Pesticide labeling must bear directions for the product use and must be adequate for the protection of the user and the public. Label statements on intended uses must be specific and not false or misleading. Directions for use must be stated clearly and in such terms that they will be readily understood by the user.

C. TO ENSURE SAFE AND EFFECTIVE USE OF PESTICIDES

1. Read the label before you purchase a pesticide to determine:

    a. If this is the pesticide required for the job. Never purchase or select a pesticide based on the color of the label. Labels of the same color and general make-up may contain different active ingredients or be intended for different purposes.

    b. Whether the material is too toxic or hazardous to be used safely. Read the precautionary statements.

    c. The amount of active ingredient in percent or pounds per gallon.

    d. If the formulation is suitable for your equipment.

    e. Where it can be applied.

2. Read the label before you mix the material to determine:

    a. Protective equipment required.

    b. Warnings, poisoning symptoms, and antidotes.

    c. What you can mix with it (compatability).

    d. How to mix it.

3. Read the label before applying to determine:

    a. When to apply it. Many pesticides are most effective at a particular stage of the pest's life.

    b. How to apply it. For example, what is the rate of application?

    c. Use restrictions.

    d. Special instructions.

4. Read the label before storing or disposing of the pesticides and their containers to determine:

   a. Where and how to store.

   b. How to decontaminate and dispose of containers.

   c. Where to dispose of the excess pesticide.

5. The uses of alternative application equipment and tank mixes not prohibited by labeling, application at less than labeling rates, and application of pesticides to unnamed target pests is allowed by 1978 amendments to FIFRA. Use under the above conditions warrants the following considerations:

   a. Responsibility for efficacy or effectiveness of the pesticide against unnamed target pest rests with the applicator.

   b. The manufacturer may not be liable for the efficacy of a product if used under the aforementioned amendments.

6. Warning Concerning Out-of-Date Sources of Pesticide Information:

Accepting information about pesticides from unreliable sources is the surest way to create problems for yourself and others. One mistake can cost you money, injure someone, or cause you legal problems.

Guard against the following:

   a. Friends mean well but often cannot remember exactly the name of a product, or in fact, they may know very little about the problem or the product.

   b. Don't be oversold by personnel in sales or others who recommend pesticides. The best source of information is from specialists who work in pest management.

   c. Interested bystanders may offer suggestions that may not be correct.

   d. Old bulletins, circulars, and mimeographed information from state or federal sources should be disregarded if current information is available.

   e. Sales catalogs may contain incomplete or out-of-date information. Doubtful recommendations should be checked against up-to-date information.

f. Memories should never be trusted. Too many pesticide chemical names sound so nearly alike.

g. Trade names may not be consistent with the actual chemical ingredient.

h. Recommendations from other states may or may not apply in Montana. Never accept recommendations on any pesticide without knowledge of the source and the validity of the source.

CHAPTER IV

PESTICIDE REGULATIONS AND GUIDELINES

A. DISPOSAL OF PESTICIDES AND THEIR CONTAINERS

Proper disposal of pesticide containers and surplus pesticides is an essential operation for most applicators and dealers. Improper disposal may create serious health hazards or cause environmental contamination. Your responsibility as an applicator or dealer continues until all excess pesticides and containers are disposed of correctly. Disposal includes, but is not limited to: burial, recycling, incineration, encapsulation, returning to manufacturer and any other approved method.

From the standpoint of public health, there is no such thing as an "empty container." Containers always retain residual amounts of pesticide. In the case of highly toxic pesticides, remaining residues may present a hazard to humans, especially children, pets, and livestock. All "empty" containers, prior to disposal, should be kept in a separate locked building, room, or enclosure used exclusively for storage.

1. Classification of Sanitary Landfills

The Montana Department of Health and Environmental Sciences has developed a system for classifying sanitary landfills for disposal of various types of waste materials. Some landfills are approved for disposal of pesticide wastes. These wastes include excess pesticides, containers and contaminated commodities and soils. No liquids are accepted.

Classification is based on geological and soil characteristics, depth of ground water, lack of surface water or flooding, and the proximity to population centers. Sanitary landfills are classified as either Class I, II or III sites. Class I sites will allow for burial of the most toxic substances. Class II and III sites will allow for burial of moderately toxic to low toxic materials.

2. Disposal of Pesticide Containers

The Montana Solid Waste Management Act (MSWMA), as it pertains to the disposal of hazardous wastes, is enforced by the Department of Health and Environmental Sciences. Section 75-10-214(1) of the (MSWMA) states, "A person may dispose of his own solid wastes upon land owned, leased, covered by easement or permit as long as it does not create a nuisance or public health hazard."

The following guidelines will help reduce the hazards of disposing of surplus pesticides and empty containers:

(a) "Empty" containers are never completely empty.

(b) Keep all empty containers in a locked storage area prior to disposal.

(c) Never puncture or burn aerosol containers.

(d) Do not reuse pesticide containers.

(e) Triple rinse and break all glass containers and bury them in a state licensed sanitary landfill.

(f) Use the Triple Rinse Method on all metal containers.

Step I. Empty containers in the normal manner and drain an additional 30 seconds.
Step II. Add the correct amount of rinse solution (usually water).

Container Size	Solution Required
1 gallon container	add 1 quart rinse solution
5 gallon container	add 1 gallon rinse solution
30 gallon container	add 5 gallons rinse solution
50 gallon container	add 5 gallons rinse solution

Step III. Replace closure, lid or bung.

Step IV. Rotate and up end container for complete rinsing.

Step V. Drain rinse into your spray and mix tank.

Step VI. Second Rinse - repeat Steps II through V.

Step VII. Third Rinse - repeat Steps II through IV.

(g) To obtain maximum drainage of the pesticide material into a tank, puncture the head of the metal container with a Posidrain tool.

(h) After rinsing has been completed, dispose of containers in a sanitary landfill or designated recycling center.

(i) Only incinerate combustible containers such as paper, cardboard, or plastic under approved conditions (consult local health authorities before burning containers). Do not burn containers which have held herbicides such as 2,4-D and its derivatives. Vapors produced from burning this herbicide may damage near by plants.

(j) Never stand in the smoke or fumes of burning containers or pesticides.

(k) Property and dispose of all unlabeled containers and their contents.

(l) Never burn herbicides or defoliants containing chlorates as they will explode when heated.

3. Disposal on Private Property

Disposal of excess pesticides and containers on the generator's private property is allowed. This process must be approved by the Department of Agriculture and the Department of Health and Environmental Sciences, Water Quality Bureau and the Solid and Hazardous Waste Bureau. Criteria on disposal is being developed by both agencies at this time. If an approved hazardous waste site is located reasonably close to your operation, you may be required to utilize that site instead of your own property for disposal. Questions regarding disposal of pesticides and containers on private property should be directed to the Environmental Sciences Division, Montana Department of Health and Environmental Sciences. Individuals improperly disposing of pesticides or their containers on private property will be in violation of the Montana Pesticides Act, the Water Quality Act, and the Solid and Hazardous Waste Laws.

4. Disposal of Large Volumes of Pesticides

Applicators or dealers desiring to dispose of larger volumes of improperly labeled, old or unusable pesticides should contact the Department of Health and Environmental Sciences, Solid and Hazardous Waste Bureau (444-2821). The Department will give technical assistance and recommendations for proper disposal to prevent environmental and public health accidents and potential legal problems.

For additional information refer to "A Guide to Pesticide Disposal for Commercial and Government Applicators in Montana".

B. PESTICIDE STORAGE

Pesticides should be stored in dry, locked, well ventilated areas where humans, livestock, and pets cannot come in contact with them. Remember, children and animals are curious and do not or cannot read labels. They do not know the hazards of pesticides.

Pesticides must always be stored in the original, labeled container with the label plainly visible. To avoid possible cross contamination, never store pesticides near human or animal food.

Stored containers should be periodically checked for corrosion, leaks, breaks, and tears. Faulty containers constitute a hazard and must be disposed of and replaced immediately. Always keep the lids and bungs tightened on containers.

Install an exhaust fan for ventilation in storage rooms to reduce concentrations of toxic fumes and to hold temperatures down. Do not permit anyone to sleep or eat in a room where pesticides are stored.

1. Guidelines for Storing Pesticides

a. Plainly label the warehouse or storage room with the words "Danger" or "Poison", along with the familiar "Skull and Crossbones."

b. Post a list of chemicals being stored.

c. Keep the storage room or building locked when not in actual use. Storage facilities should have limited access.

d. Locate storage facilities as far as possible from other buildings and populated areas or away from normal pedestrian traffic within a dealer or applicator facility. Fence the area if necessary.

e. When large quantities of pesticides are to be stored, install a sprinkler system.

f. All combustible materials should be kept away from steam lines or other heating devices.

g. Glass containers of chemicals should not be placed in sunlight.

h. Use fire proofing material such as sheet rock in the building.

i. Inform the fire department and your physician in writing of the nature, quantities, and hazards of these compounds. Ask your local fire chief to inspect your facility at least once a year.

j. Keep these individuals informed as to any changes in quantities, hazards, or nature of the contents of the facility.

k. Make sure employees are familiar with the building's fire fighting equipment, alarms, and fire exits and the hazards of each pesticide product.

l. Fire fighting equipment should be checked periodically and ready for use at all times.

m. Request your physician or local hospital to have, on hand, the antidotes required in case of poisoning.

2. Pesticide Fire and Explosion Hazards and Precautionary Guidelines

Interpretation 18, Revision II of the regulations for the enforcement of FIFRA, as amended, requires that fire hazard cautions be based on the flash point of the particular product. Read the label when storing any pesticide and store each chemical in accordance with directions to prevent fires and explosions.

Many users of pesticides are aware of the contamination and public health hazards when applying chemicals, but do not recognize hazards from chemical fires. Fire prevention in pesticide storage areas does not always receive the attention it should when planning for storage structures and sites.

Many pesticides containing oils will burn readily or the containers will explode when over-heated. Some solvents used as carriers are highly flammable and explosive. Fumes and smoke from chemical fires can be highly toxic to fire fighters and residents in the area. Herbicide "smoke" can also be phytotoxic to nearby plants.

Identify pesticide storage areas with prominent, water-proof signs over each entrance, including any windows. Storage entrances should always be locked when not in use. If a fire occurs, protect nearby residents by evacuating those down-wind. After the fire is out, the contaminated area should be roped off and supervised continuously until cleanup is completed.

Inform local police, fire departments, and public health officials in writing of the location and layout of the storage area, type of materials stored, and hazards involved. Provide phone numbers of persons responsible for storage with the fire chief. Fire departments should have a map with locations of all pesticide storage facilities in their areas. Inform local physicians and hospitals of potential hazards and be sure they know how to treat poisonings caused by the pesticides.

Cleanup procedures after the fire should be handled by persons familiar with pesticides and their hazards. Notify all local public health officials so correct decontamination procedures will be followed. Check with pesticide manufacturers for additional advice and use of their expert decontamination team, if necessary.

The Manufacturing Chemist's Association has introduced a program to provide emergency information to fire and police crews responding to transportation accidents and fires involving hazardous chemicals. The nationwide CHEMREC emergency number is (800 424-9300.

3. Pesticide Storage Life

Individuals should also be concerned about the storage "life" of each pesticide formulation in the storage facility. Some labels provide information on storage standards for the particular pesticide product. If storage information is not available locally, contact the proper company representative for recommendations. The following information provides an example of potential storage problems:

DDT and other chlorinated hydrocarbons are very stable and can be stored for a number of years with little or no chemical change. Organophosphorus pesticides such as TEPP, Parathion, and others have a relatively short storage life. Certain atmospheric conditions can bring about the degradation of these materials. Labels will warn of such limitations and specify steps for prevention of pesticide deterioration.

Liquid concentrates stored at low temperatures for prolonged periods of time may crystallize, separate out, or break down. The resultant material may be more or less toxic than the original, or may not perform as originally intended.

C. TRANSPORTATION OF PESTICIDES

The importance of preventing the spillage of toxic chemicals during transportation cannot be over emphasized. Whenever a spill occurs in or about any transport complex, the possibility of endangering the lives of others is increased. Fires resulting from accidental toxic chemical spillages have been the direct cause of death by inhalation of toxic smoke and have resulted in permanent injury or serious health problems for individuals involved in fighting these fires. Spillage of hazardous pesticide in transport must be considered an emergency, requiring prompt cleanup, protection of human health, safe disposal of damaged containers and damaged cargo, and possibly the ultimate disposal of the transport. Handling these emergencies usually requires assistance of technically trained personnel. Chemical spillage has caused poisonings among transportation personnel and others. Whenever a pesticide accident occurs, the welfare of persons directly involved and the general public must be protected.

Spillage results from breakage of glass containers, puncturing of drums or cylinders, defective valves or fittings on tanks, and sacks that are torn. Transportation accidents many times result from the carelessness of shipping personnel loading transports and vehicle accidents. Interstate commerce laws require that all transports and hazardous cargoes be properly labeled. Pesticide products should never be transported with food stuff, drugs, toys, clothing, cosmetics, or household items. These items would become particularly hazardous if contaminated with toxic pesticides.

1. Guidelines for Handling Transported Pesticides

   a. Employers are responsible for training employees on the hazards of loading pesticides.

   b. Employers should read all container labels.

   c. Employers should check for damage and leaking containers.

   d. Employers should know whom to contact in case of an emergency.

   e. Hazardous cargo should be handled with extreme care.

   f. Employees transporting pesticides should develop a procedure for handling spillage.

2. Guidelines for Transportation Safety Equipment

Every transport or any vehicle transporting hazardous materials should carry:

   a. An emergency water supply for washing off corrosive and toxic materials,

   b. An approved gas mask, goggles, or face shield to protect the eyes and face,

   c. Equipment for washing eyes such as a portable eyewash fountain or wash bottle, and

   d. Waterproof, impervious, complete outer clothing to wear when cleaning up or when exposed to corrosive or toxic materials. The best protection against most of the major hazards are impervious (neoprene) gloves, boots, hat and long sleeved, buttoned coats or suits. Manufacturers will provide specifications on special gear required for particular chemicals.

3. Guidelines for Safety Equipment in Loading Areas

Every permanent station where hazardous materials are loaded should have:

a. An emergency deluge shower,

b. An eyewash fountain, and

c. Protective equipment for two or more persons.

4. Guidelines for Pesticide Transportation Accidents

When an accident involving a hazardous material occurs, emergency personnel such as highway patrol, sheriff, police, or fire department personnel are usually the first on the scene. These individuals should be familiar with the hazards of toxic materials and can provide necessary assistance.

Clothing contaminated with chemicals should be removed immediately and exposed skin areas thoroughly washed. Individuals providing first aid should take special care not to become contaminated. Individuals receiving chemical burns or who are significantly contaminated with pesticides should be taken to the nearest physician or emergency hospital. Provide the physician or hospital personnel with the product label.

The cleanup crew must include at least two individuals. The crew must have all necessary protective equipment. To prevent harm to the public, especially children, pets, and the environment, leaking containers and contaminated cargo must be properly disposed of in an approved site.

5. U.S. Department of Transportation

The U.S. Department of Transportation is the primary agency regulating the transportation of hazardous materials. Title 49 - Transportation, Code of Federal Regulations, established the minimum standards for transporting pesticides and other hazardous materials. Persons engaged in intrastate or interstate transportation of pesticides should be familiar with this code.

a. Hazardous Materials Definitions

The following definitions of poisons have been abstracted from Title 49 - Transportation, Code of Federal Regulations, parts 170-189:

Class A - Extremely hazardous poisons. Poisonous gases or liquids of such nature that a very small amount of the gas or liquid mixed with air is dangerous to life.

Class A poisons are materials having: an oral LD$_{50}$ rating of less than 5 mg/kg; a dermal LD$_{50}$ of less than 75 parts per million in air or LC$_{50}$ of less than 100 mg/kg in contact with skin for less than 1 hour.

Class B - Less dangerous poisons. Substances, liquids or solids (including pastes or semisolids), other than Class A or Class C poisons which are known to be toxic to man as to afford a health hazard during transportation or which, in the absence of adequate data on human toxicity, are presumed toxic to man. (Many pesticides are classified as Class B poisons.) A Class B poison is any material with an oral LD$_{50}$ less than 50 mg/kg; LD$_{50}$ of less than 200 parts per million in air and a LC$_{50}$ to less than 200 mg/kg in contact with skin for less than 1 hour.

Class C - Tear gas or irritating substance. Liquid or solid substances which, upon contact with fire or when exposed to air, give off dangerous or intensively irritating fumes.

b. Container Specification

Each hazardous material, depending upon its characteristics, is required to be packaged in a specific type of container. Containers must meet standards established by the Department of Transportation (DOT). Routine inspections of container manufacturing plants are conducted by the DOT. Any failure of containers should be reported to the DOT. A specification number may be found on each container and reported to the DOT.

c. Placarding Transports

Vehicles transporting hazardous materials must be placarded. These placards provide emergency personnel a quick reference as to the cargo being transported. Individuals reporting chemical transport accidents should always attempt to describe the placard on the vehicle to the proper authority. Authorities will then know of potential problems in advance and may contact other necessary authorities.

6. Pesticide Applicator Transportation Accidents

Pesticide applicators must be aware of the potential danger of traffic accidents while transporting pesticides. Types of accidents which could occur are breakage of high pressure hoses or rupturing of spray tanks during a collision.

If an accident occurs, the first thing to do is to clear the area and decontaminate all parties involved, including yourself. Make sure all people, especially children, pets, and other animals are restricted from the area. Contact the Environmental Management Division in Helena (449-2944) for assistance and support. For hazardous material emergencies contact the Montana Disaster and Emergency Services at 444-6911.

If any water resources are in close proximity to the accident, you must contact the Water Quality Bureau, Department of Health and Environmental Sciences (449-2406).

D. PESTICIDE RECORD KEEPING

Applicator and dealer records of pesticide sales and use are important because they provide a history of your operation. Meaningful records will also serve to protect your business and assist you in evaluating your investment in terms of expenses, profits derived, and in maintaining an inventory.

There are many different record keeping systems that may be utilized by applicators and dealers. These systems may range from field notes and records to office sales, use and inventory records, to the use of computerized records for larger operations.

1. Dealer Records

The Administrative Rules of Montana (Sec. 4.10.504) governing the Montana Pesticides Act states:

a. All pesticide dealers, including pharmacists, veterinarians, and certified pharmacies shall be required to maintain shipping, purchase, or invoice records of all pesticide products received. These records must be retained for two (2) years. Each dealer, including pharmacists, veterinarians, and certified pharmacies shall maintain a complete and accurate record of all restricted use pesticides purchased and sold. These records must be retained for two (2) years.

b. The sales record shall include for each individual sale of a restricted use pesticide:

(1) The company or manufacturer's name on the label.

(2) The trade name.

(3) The EPA registration number.

(4) The volume sold.

(5) The license or permit number of the certified applicator.

(6) The signature of the certified applicator or purchaser.

c. Records required of dealers, pharmacists, veterinarians, and certified pharmacies shall be subject to inspection by authorized employees of the Department of Agriculture at all normal business hours, including those dealer outlets that open before 8:00 a.m. or close after 5:00 p.m. Dealers shall be required to submit the records, or a true and accurate copy of the records, to the department upon written request. The records may be computerized or coded provided that the department is provided a key to the system for monitoring, tabulating, and enforcement purposes.

d. (1) Each dealer, including pharmacists, veterinarians and certified pharmacies selling restricted use pesticides shall submit to the department written records containing the information in rule 4.10.504. The records shall be submitted within fourteen (14) calendar days after the end of the calendar month that the pesticides were sold. The records shall be made on the standard forms provided by the department or on forms approved by the department.

(2) If no restricted pesticides are sold during a given month, this should be so documented to the department.

e. (1) Each dealer shall submit to the department an accurate typed or printed report of their calendar year sales of general use pesticides. This report shall include the total volume sold, the trade name and the company name of each individual product.

Example:

ABC company	Weed Killer 4	200 gallons
NMO company	Malathion 5	175 gallons
XYZ company	Granular 8	500 lbs.

The report on the annual sale of general use pesticides shall be provided to the department within fourteen (14) calendar days after the end of each calendar year. The reports shall be made on the standard forms provided by the department or on forms approved by the department.

(2) If no general use pesticides are sold during the calendar year, this should be so documented to the department.

2. Applicator's Records

The Administrative Rules of Montana (Sec. 4.10.207) governing the Montana Pesticide Act states:

a. All licensed, certified-licensed, commercial, public utility, government applicators, and certified non-commercial applicators shall be required to keep and maintain operational records for two (2) years. For every application performed either by an applicator or operator, the application record shall include:

(1) The name of the applicator or employee applying the pesticide. Initials or an assigned number are acceptable if the full name of the applicator or operator is cross-referenced.

(2) The date of application.

(3) The time of application. This should be as specific as possible but it may be recorded generally as a.m. or p.m. for such things as rights-of-way applications, fogging cities, and other similar applications.

(4) The location should be recorded as specific as possible but may generally be expressed as the owner, leasee, or administrator's land area, farm or ranch buildings, premises, etc. Right-of-way, and similar applications may be expressed in general terms of identifiable landmarks.

(5) The type of equipment. If the same piece of equipment is used for all applications, then reference to this equipment may be listed only once. If more than one piece of the same equipment is utilized, then the applicator may assign a separate number to each piece of equipment and may list the equipment once by description and thereafter by number.

(6) The pesticide or pesticides used which shall include the company or manufacturer's name, trade name, and type of formulation.

(7) The rate of application used.

(8) The amount of area treated (acres, trees, livestock, square feet or yards, etc.) or for structural applications, the type of treatment.

(9) The primary pest or pests involved.

(10) The stage of crop development, if applicable.

(11) The weather conditions for those operators, such as aerial, in which the temperature and wind velocity could affect the effectiveness of the application as well as present a hazard to humans, property, sensitive crops, or animals in the area.

b. (1) Applicators shall submit to the department an accurate typed or printed monthly record of each application performed with all restricted use pesticides. The records shall be submitted within fourteen (14) calendar days after the end of the calendar month that the pesticide or pesticides were applied. The records shall be submitted on the standard form provided by the department or on forms approved by the department. The record shall contain the following items listed in the rule: (1) (a), (b) (i), (iii), (d), (e), (f), (g), (h), and (2). The record may contain all the items listed in sections (1) and (2).

(2) If no applications of restricted use pesticides are made during a given month this shall be documented to the department.

c. (1) Applicators shall submit to the department an accurate typed or printed annual report of their use of general use pesticides. The report shall include a summary of use of these pesticides by county, month, total acreage, amount of the formulated product used, crop or site treated, and the product used by company name and trade name. The annual report shall be submitted to the department within fourteen (14) days after the end of the calendar year. The report shall be submitted on the standard form provided by the department or on forms approved by the department.

(2) If no application of general use pesticides are made during the calendar year, this shall be so documented to the department.

d. Applicators utilizing two or more pesticides in a tank mixture shall be required to record all data required by this rule. Applicators may place the record data into any format desired. The records may also contain such other information and data as the applicator desires. The records may be computerized or placed into a coded format provided that a key to the system is provided to the Department. Applicators shall maintain application records on a daily basis not to exceed twenty four (24) hours from the time of the last application.

e. Applicator records shall be open to inspection by authorized employees of the department at all reasonable business hours. This may include hours prior to 8:00 a.m. or after 5:00 p.m., depending on the work schedule of the applicator. Applicators shall also be required to submit their records or any portion of the records requested in writing by the Department.

f. The Department may establish special record-keeping systems for applicators conducting special or emergency pest management or control programs or for applicators handling extremely hazardous pesticides which could have a significant effect on the environment or on human health. Seed treaters and wood product treaters are exempt from this rule. Certain other similar applicators as determined by the Department may be exempt from some record-keeping requirements of this rule. These exempted applicators shall be required to meet all other requirements of this rule and to maintain an inventory by invoice of pesticides purchased for their operations.

g. Individual applicator records shall not be public records except in those cases established and set forth by a District Court. The Department may summarize records for publication for groups of categories of applicators.

h. Applicators must file incident reports. Sec. 4.10.105 of the Administrative Rules of Montana states:

> (1) An applicator, who through his own actions or omissions, or the actions or omissions of his employees, causes or allows any pesticide to escape onto or to be deposited onto the person, lands, or property of another, not the person hiring or contracting for his services, shall be required to file a written report to the Department within forty-eight (48) hours of the incident, specifying the location of the incident, the name of the location of the incident, the name of the pesticide involved, the type of formulation, the method of application, the name and address of the person for whom the application was being made, and the name and address of the person(s) whose land, person, or property was subjected to the unintentional pesticide application. In addition, if the pesticide is classified as either Extremely Toxic or Highly Toxic to people or animals, the applicator or

operator shall immediately cease his application and notify the landowner or operator whose land, person, or property was subjected to unintentional pesticide application and to the Department, immediately, by the quickest available means, after applying first-aid or personal decontamination if appropriate.

(2) A complete record of all settled and pending claims from the preceding licensing period must be filed when reapplying for an applicator's license. The record shall indicate for each and every incident, the names of all parties involved, the location of the incident, the manufacturer and the technical name of the pesticide involved, the type of formulation, the method of application, the intended use and the target or site, specifying the animals, wildlife, plant, and aquatic life, soil, or people subjected to the unintentional pesticide application.

(3) For settled claims, report the information required in (2) above, together with the dollar amount of the economic loss and the final settlement agreement between all parties.

Applicators failing to file the foregoing reports, or falsifying them in any fashion, shall be subject to immediate revocation of current licenses and/or shall not be issued a license until the requirements of this section are fully satisfied.

E. PESTICIDE APPLICATOR LIABILITY

Any pesticide application by a commercial or government applicator involves a certain degree of risk to the applicator, other individuals, and domestic livestock and at times to the environment and wildlife. Pesticide liability can be shifted from the applicator to the contractor due to the "Inherently Dangerous Doctrine." This doctrine provides that, while an employer is not liable for the acts of an independent contractor, certain operations are considered so dangerous that responsibility cannot be shifted from the contractor.

CHAPTER V

TOXICOLOGY OF PESTICIDES

Toxicology is the study of harmful effects of a chemical on living things. In the quest to determine how harmful a chemical is on a living organism, information is also obtained on the chemical's degree of safeness. When describing the degree of harmfulness or safeness of a chemical, the terms "toxic" and "toxicity" are commonly used. The toxicity of chemicals is always qualified by the type of laboratory test performed, the quantity causing effects on the biological organisms, the biological organism tested, and other conditions of the study.

Toxicity data are based upon tests with laboratory animals. At best, these toxicity values are only indirectly related to man. Human experience with exposure to chemicals is the best guide to human toxicity. No actual scientific tests have been conducted in which humans have been subjected to lethal doses of chemicals. However, the effects of some chemicals on humans have been obtained from reports of accidental exposures and suicides. This information is fragmentary and we must rely upon data obtained from animal tests. Extrapolation or correlation of animal toxicity tests as to their effects upon humans must therefore be made with caution.

A. TESTS FOR DETERMINING TOXICITY

There are a number of laboratory tests used to evaluate the toxicity of a chemical. The basic types include:

1. Acute tests, conducted by administering a single dose of chemical orally, dermally, subcutaneously, or via the respiratory route, and observing the effects on test animals over a one week period.

2. Prolonged or chronic tests extend over a period of three months or as long as one or two years.

3. Specific tests are performed to reveal additional adverse characteristics of a chemical. Adverse effects of a special nature include:

    a. Potentiation (Synergism) -- Where the effect of a combination of two chemicals is greater than the sum of their individual effects. A contrasting phenomenon occurs when the toxicity of a pesticide may decrease when administered to a test animal pretreated with a different pesticide. This phenonmenon is called antagonism.

    b. Teratogenesis -- Where the effect of a pesticide administered to a test animal causes birth defects or abnormalities in developing young (including fetus).

c. Carcinogenesis -- Where the effect of a pesticide administered to a test animal produces cancerous growths.

d. Mutagenesis -- Where the effect of an administered pesticide on a test animal causes genetic damage resulting in hereditary changes.

Toxicity tests are not confined to animals. Toxicity evaluations are also made on plants (phytotoxicity). For example, sulfur, oils, and numerous other chemicals may be toxic to plants.

For the purposes of this chapter, this discussion will relate to animal toxicity only.

4. Toxicity values are expressed in a number of ways depending upon the method of administration and the effect the researcher is interested in. They may be expressed as:

Acute oral LD_{50} in terms of milligrams of the substance per kilogram (mg/kg) of body weight of the test animal.

Acute dermal LD_{50} in terms of milligrams of the substance per kilogram (mg/kg) of body weight of the test animal.

Inhalation data in terms of micrograms of dust or mist per litre of air (mg/l) or parts per million by volume of gas or vapor (ppm). One microgram equals one millionth of a gram.

Skin sensitivity expressed in terms of the amount of substance applied per square centimeter of skin (mg/cm2) causing little or no (N), moderate (M), or severe (S) skin irritation.

LD means lethal (fatal) dose, and LD_{50} means the lethal dose that will kill 50% of a population ~~of~~ test animals. LC means lethal concentration and LC_{50} means the lethal concentration that will kill 50% of the test animals. In some cases, the lethal dose (LD) or lethal concentration (LC) may be expressed as LD90 or LC80; the lethal dose to kill 90% of the test animals and the lethal concentration to kill 80% of the test animals respectively.

a. Acute oral refers to a single dose taken by mouth or orally.

b. Acute dermal refers to a single dose applied directly to the skin (skin absorption).

c. Inhalation refers to exposure through breathing or inhaling a predetermined contaminated atmosphere.

Acute toxicity values of one compound are more meaningful when compared with another chemical, and with similar test animals and laboratory tests.

Chemical:	Ethyl Parathion	DDT
Description:	Organophosphate	Organochlorine
Toxicity Rating:	Acute Oral LD_{50} (rat) 3.6 mg/kg Acute Dermal LD_{50} (rat) 6.8 mg/kg	Acute Oral LD_{50} (rat) 113 mg/kg Acute Dermal LD_{50} (rat) 2510 mg/kg

Acute toxicity can be a function of the amount of toxicant received, the route of administration, and the type of animal tested. A host of factors may alter the "predicted" effect of a chemical on a living organism. These factors are:

a. the physical and chemical properties of the pesticide or its formulation,

b. the pesticides mode of action (e.g. how the pesticide causes tissue damage or poisoning),

c. age, sex, and race,

d. size and weight,

e. condition of health,

f. genetic characteristics,

g. individual susceptibility,

h. the hazard confronting the applicator,

i. nutrition,

j. temperature and environmental factors.

Chronic toxicity results from prolonged, repeated, or continuous exposure to a chemical. This is usually the result of exposure to levels lower than that necessary to cause acute toxicity and often demonstrates a delayed response. Public concern toward pesticides generally focuses on possible chronic toxicity. Sublethal poisoning or exposure may be expressed by any of the following:

a. skin/eye irritation,

b. nervous system disorders,

c. reproductive system disorders,

d. damage to other organ systems (liver, kidney, lungs, etc.)

e. birth defects,

f. mutations,

g. cancer.

Skin irritation (dermal exposure) may be in the form of chemical burns, dermatitis or eczema. Skin irritation is also characteristic of some highly toxic pesticides. However, it is not observed frequently because users generally protect themselves from skin contact with these chemicals. Dermal toxicity data for chemicals used in plant disease control (fungicides), as well as herbicides and plant growth regulators, are limited. A number of these compounds are of low mammalian toxicity or are not readily absorbed through the skin. Some animal tests and human experiences have shown several of these chemicals to be irritating to the skin and eyes, which in severe cases may be incapacitating.

B. HEALTH HAZARDS OF PESTICIDES

It is common habit to depend exclusively on acute toxicity values when evaluating the effect of a chemical on humans or other animals. Judgments regarding chemical safety based upon this single consideration can be short-sighted and often erroneous. Users of pesticides should be additionally concerned with the hazard associated with the exposure to the chemical, and not exclusively the toxicity of the material itself. These two terms are not synonymous; both must be considered when determining safety precautions.

Toxicity is the inherent capacity of a substance to produce injury or death. Hazard is a function of two primary variables, potency (quantity of a chemical needed to induce harm) and exposure; and is the probability that injury will result from the use of a substance in a given formulation, quantity or manner. A compound may be extremely toxic but present little hazard to the applicator or others when used:

1. in a very dilute formulation,

2. in a formulation that is not readily absorbed through the skin or readily inhaled,

3. used only occasionally and under conditions to which humans are not exposed, or

4. used only be experienced applicators who are properly equipped to handle the chemical safely.

A chemical may exhibit relatively low-mammalian toxicity but present an increased hazard because it is normally used in the concentrated form, or may be readily absorbed or inhaled, or is used frequently and stored improperly by non-professionals unaware of the ways pesticides enter the body and their actions within the body.

With most pesticides, regardless of their toxicity values, formulation, or dilution, a health hazard exists when:

1. appropriate protective clothing is not used,

2. good personal hygiene is not practiced,

3. chemicals are improperly stored, transported, or disposed of,

4. an applicator is unaware of the greatest exposure hazard in his operation,

5. an applicator applies a chemical improperly mixed, or applies it at the wrong rate.

The relationship between toxicity and hazard can best be put into perspective if we focus our attention on aspirin, a common standard erroneously used by many to evaluate toxicity values of pesticides. Aspirin has an LD_{50} of 1,200 mg/kg and is considered slightly toxic (to some it is considered harmless). Yet, aspirin is responsible for more than 10% (8,437) of all poisonings among children under five years of age. In the home, in non-child-proof bottles, on an open shelf, aspirin is an extreme hazard. See Table 2.

C. ACUTE PESTICIDE EFFECTS ON HUMANS AND RECOGNITION OF THEIR SIGNS AND SYMPTOMS

The particular way a pesticide affects a human (or any living things) is referred to as Mode of Action. Even though we may not know how a pesticide poisons the body in all cases, the signs and symptoms resulting from such poisonings may be well known. Early signs and symptoms serve as warnings of the body in response to pesticide exposure. These warnings should be recognized by those using pesticides. The signs and symptoms of poisoning may be quite variable among individuals and may depend upon whether the exposure is to a large quantity of toxicant (e.g. splash or spill) over a short period of time or to smaller quantities over an extended period of time.

Any experience of signs and symptoms associated with a recent history of exposure should be reported to your physician. You should advise him of the signs and symptoms, the pesticide utilized, method of application, amount and time of exposure and the conditions of exposure. A complete label must be provided to your physician. The following types of pesticides and their signs and symptoms are listed for your benefit.

1. Organophosphate Pesticides

Examples: EPN, Parathion, Disyston, Systox, Phorate (Thimet), Diazinon, Malathion, Phosdrin.

a. Mode of Action: Cholinesterase inhibition

Organophosphate insecticides attach themselves to a chemical found in the blood, the nervous system and the junction between the nerves and the various other tissues of mammals. This chemical is called cholinesterase and is essential to the normal functioning of the nervous system. During normal muscle function, acetylcholine is released by a nerve impulse and it acts on that muscle to produce the contractile response. Cholinesterase is then released and by breaking down acetylcholine, helps restore the muscle to its normal resting state. When an organophosphate insecticide is present in the system, it blocks the function of cholinesterase by attaching to it and is referred to as a cholinesterase inhibition. This "tie-up" of cholinesterase by the insecticide keeps the muscle in an active (contracted) state and is characterized by muscle twitching and weakness (tremors and fibrillations respectively) and may cause fits and convulsions which are simply uncontrolled, violent muscle actions.

b. Signs and Symptoms:

Early signs and symptoms include headache, giddiness, nervousness, blurred vision, weakness, nausea, cramps, and diarrhea.

Later signs and symptoms include heavy sweating, constricted pupils, tearing, salivation, vomiting, bluing of skin and muscle twitching.

Advanced signs and symptoms include convulsions, coma, loss of reflexes, and inability to control bowels or bladder.

Occupational illness may be delayed several hours with symptoms not becoming apparent until after the worker has returned home.

Table 2

Combined Tabulation of Toxicity Classes

by

Route of Absorption

Toxicity Rating	LD_{50} Single Oral Dose Rats mg/kg	LD_{50} Single Dermal Dose Rabbits mg/kg	Probable Lethal Oral Dose for Man	LC_{50} Lethal Concentration
Extremely toxic	1 mg or less	20 mg or less	a taste, a grain	75 ppm
Highly toxic	1 - 50 mg	20 - 200 mg	a pinch, 1 tsp.	200 ppm
Moderately toxic	50 - 500 mg	200 - 1000 mg	a tsp. - 2 tsp.	
Slightly toxic	500 - 5000 mg	1000 - 2000 mg	1 oz. - 1 pt.	
Practically nontoxic	5000 - 15,000 mg	2000 - 20,000 mg	1 pt. - 1 qt.	
Relatively harmless	15,000 mg	20,000 mg	1 qt.	

2. Carbamate Pesticides

Examples: Carbaryl (Sevin), Baygon, Zectran, Thiram, Vapam

a. Mode of Action: Cholinesterase inhibition

The mode of action of carbamates differ from organophosphates in that their effect on cholinesterase is brief. Carbamates are broken down rapidly in the body, or the tied-up cholinesterase is quickly reversed to its functional form. Measurements of blood cholinesterase of humans or other animals exposed to carbamates are likely to be inaccurate and always in the direction of appearing to be normal.

b. Signs and Symptoms:

The signs and symptoms of carbamate poisoning are essentially similar to those of organophosphate insecticides.

3. Organochlorine Pesticides

Examples: DDT, Lindane, Endrin, Dieldrin, Chlordane, Aldrin, Toxaphene, Heptachlor

a. Mode of Action: Neurotoxin

Organochlorines are neurotoxic to the central nervous system (brain and spinal cord) and toxic to the kidney and liver in large doses. The exact mode of action of organochlorines is not clearly understood. It is currently believed that DDT is lethal because of its effects on sensory nerves (nerves which detect changes in heat, cold, light, as well as physical and chemical changes within the body).

b. Signs and Symptoms:

These include nausea, vomiting, restlessness, tremors, apprehension, convulsions, coma, respiratory failure and death.

4. Phenolic Compounds

Examples: DNOC (dinitrocreosol), DNBP (dinitrobutylphenol) and Pentachlorophenol

a. Mode of Action:

Speeds up certain bodily processes and functions with resulting increases in body heat beyond tolerable limits. The onset of illness is sudden and course of the poisoning is rapid. If death occurs, it probably will occur within 24 to 48 hours. Phenolic compounds are also skin sensitizing, causing skin irritation, dermatitis and chemical skin burns.

b. Signs and Symptoms:

In chronic or extended cases of poisoning, nervousness, sweating, unusual thirst, and loss of weight have been observed. Characteristic signs and symptoms are weakness, loss of appetite, constriction in the chest, shortness of breath, and excessive sweating. Symptoms may be similar to those of organophosphate poisoning. It is imperative that poisoning by these compounds not be mistaken for organophosphate poisonings, as the administration of the organophosphate antidote (atropine) can be fatal.

5. Arsenic

Examples: arsenic trioxide, sodium arsenite, paris green, and organic arsenicals (disodium methyl arsenate - DSMA)

a. Mode of Action:

These compounds poison the cells of certain body tissues and affect certain enzymes, slowing down a number of the body's normal functions.

b. Signs and Symptoms:

Generally includes vomiting, diarrhea, pains in the throat, stomach and bowels, dehydration, thirst, muscular cramps, headache, dizziness, convulsions and drop in blood pressure.

6. Botanical Toxins (plant derivatives)

Examples: Pyrethrum - the active ingredients are derived from the plant and flower *Chrysanthemum cinerariaefolium* exported from Kenya and Equador.

a. Mode of Action:

Injury to man from pyrethrum usually results in minor cases of skin allergies, sneezing, running nose, and some cases, stuffiness of the nose. Some people are highly sensitive to pyrethrum and may experience severe illness. Most cases of poisonings resulting from the direct toxicity of pyrethrum have occurred in children, indicating that children have a smaller capability of detoxifying pyrethrum.

Examples: Strychnine - the active ingredient is derived from dried ripe seeds of Strychnos Nox-vomica.

a. Mode of Action

The mode of action of this chemical is not clearly understood. It is known to act on the spinal cord causing massive stimulation of all muscles simultaneously.

b. Signs and Symptoms:

Sometimes the muscles of the legs and face become stiff. In some cases, the patient may become extremely restless and become convulsive. Cold sweat covers the skin and the patient sometimes falls asleep from complete exhaustion.

From one to ten violent attacks may occur before the patient recovers or death results due to an inability to breath. Any sound or movement will elicit a spasm. In the absence of medical treatment, most victims do not tolerate more than five convulsions, and death usually follows 3 to 5 hours after consuming a fatal dose. Chances of recovery are good if a patient survives the first 5 to 6 hours.

7. Rodenticides

Example: Sodium fluoroacetate (1080)

a. Mode of Action:

The mode of action of this chemical is not clearly understood. It is currently believed that 1080 must be transformed ("lethal synthesis") in the body to another chemical form which is the toxic agent. 1080 appears to have its most drastic effect on the heart and nervous system in most animals.

b. Signs and Symptoms:

Acute poisoning by 1080 is characterized by vomiting, excitability, convulsions, irregularity of heart and breathing rates, exhaustion, coma, and respiratory depressions. Death results from respiratory failure associated with collection of water in the lungs.

Example: Anticoagulant - Warfarin, Pival, Diphacin, Fumarin

a. Mode of Action:

These chemicals reduce the ability of blood to clot and maintain the integrity of the blood vessels. The result is hemorrhaging of capillary beds and other blood vessels, causing internal bleeding.

b. Signs and Symptoms:

In an attempted suicide case, when one individual consumed an equivalent of one pound of bait (0.925% warfarin) per day for six consecutive days, symptoms began with back and intestinal pains. These pains occurred one day after the six daily doses had been taken. One day after the initial symptoms, vomiting and severe attacks of nose bleeding occurred. On the second day of illness, small red patches appeared on the skin in the form of a rash. There was blood in the patient's urine.

8. Fumigants

Example: Methyl Bromide

a. Mode of Action:

Central nervous system depressant; affects protein molecules in certain cells of the body.

b. Signs and Symptoms:

Causes chemical burns of the skin and other exposed tissues, delayed chemical pneumonia (producing water in the lungs), severe kidney damage and extreme nervousness. Inhalation of small amounts of methyl bromide produces symptoms similar to alcoholic intoxication. Skin rashes occur from repeated mild exposure. Sometimes mental confusion, double vision, tremors and lack of coordination and slurring of speech may occur.

Example: Carbon Tetrachloride

a. Mode of Action:

Depresses and injures almost all cells of the body, including those of the central nervous system, liver, kidney, and blood vessels. The heart muscle may be depressed, causing irregular heart rhythm.

b. Signs and Symptoms:

The immediate effect of acute poisoning is abdominal pain, nausea, vomiting, dizziness and confusion progressing to unconsciousness, slowing of respiratory rate, irregular pulse, and fall of blood pressure. Vague symptoms suggestive of chronic poisoning include: fatigue, occasional vomiting, abdominal discomfort, anemia, weakness, nausea, blurring of vision, memory loss, tremors and loss of peripheral color vision. Dermatitis follows repeated skin exposure.

Examples: Cyanide Fumigants - hydrocyanic acid, hydrogen cyanide, cyanogas, organic bound cyanide.

a. Mode of Action:

Cyanide inactivates the cellular activities and functions of all tissues of the body by "tying up" certain key cellular enzymes.

b. Signs and Symptoms:

At low dosages, cyanide poisoning may produce weakness, headaches, confusion, and occasionally nausea and vomiting. There is an initial increase in blood pressure and slowing of heart rate, followed by rapid and irregular pulse and constriction of the chest. Subsequent unconsciousness, convulsions, and death from respiratory failure will follow repeated exposure to sublethal doses. A massive dose will produce unconsciousness and death without warning.

9. Solvents

Examples: diesel oil, kerosene, gasoline, xylene, benzene

a. Mode of Action:

Solvents and other carriers may contribute to the danger of pesticide formulations either through their inherent toxicity or by affecting the solubility of the active ingredients. Solvents of this type are fat solvents and alter the function of nerves, resulting in depression, coma, and sometimes convulsions. They may affect the liver, kidneys, and bone marrow. Irritation and damage to the lungs may occur if the solvent is inhaled into the lungs. These petroleum hydrocarbons have a low surface tension, small amounts may spread over a large area in the lungs.

b. Signs and Symptoms:

The principle symptoms of poisoning with these agents are lung irritation, central nervous system depression, weakness, dizziness, slow and shallow respiration, unconsciousness and convulsions. Chronic poisoning is characterized by dizziness, weakness, weight loss, nervousness, pains in the limbs, peripheral numbness, and burning sensation in the extremities.

10. Herbicides

Examples: Phenoxy Herbicides - 2,4-D, 2,4,5-T, 2,4,5-TP

a. Mode of Action:

Toxic properties of phenoxy herbicides are generally due to their skin sensitizing capability or to the toxic properties of the solvent.

b. Signs and Symptoms:

Reports by Montana physicians show that phenoxy related herbicides have been frequently associated with mild skin irritation, massive dermatitis, and eczema. In one case, a worker was incapacitated for four days, undergoing cortisone treatment for massive dermatitis resulting from exposure to 2,4-D spray.

Example: Paraquat

Small oral doses may cause irreversible lung damage resulting in death. Disturbance of nail growth and irritation of the eyes and skin are associated with this chemical's misuse.

D. HOW PESTICIDES ENTER THE BODY (EXPOSURE)

Chemicals may enter the body by the following routes:

Contact and absorption of the material by the skin referred to as "dermal exposure,"

Breathing the fumes, vapors or dusts, referred to as "inhalation exposure,"

Eating or drinking the material, referred to as "oral exposure," and

Direct entrance or absorption through cuts, abrasions, or burns, referred to as "wound exposure."

1. Dermal Route

Absorption through the skin is the most important route of entry of pesticides into the body especially when liquid sprays and emulsifiable concentrate formulations are involved. Most of the pesticides to which the body is subjected during typical exposure situations, especially to applicators of liquid sprays, is deposited on the skin. Dermal exposure is undoubtedly responsible for most poisonings occurring in the field.

The greatest dermal penetration for Parathion on man occurs in the scrotal area (100% absorption of the applied dose). The head and neck are areas of greater absorption than arms and hands. A high degree of absorption (46.5%) occurs in the ear canal. Exposure in this area could occur through drift of fine pesticide mists or dusts or by digging in the ear with the tip of the finger.

In general, wettable powders, dusts, and granular pesticides are not as readily absorbed through the skin and other body tissues as are liquid formulations such as emulsifiable concentrates containing a relatively high percentage of toxicant in a solvent.

The implications of these factors and relationships emphasize a need for providing protection of critical areas receiving high exposure. Table 3 presents information on the degree of hazard from various formulations and methods of applications relating to specific body parts.

2. Respiratory Route

Absorption of a chemical by the lungs is rapid and very complete. Pesticide absorption through the lungs is of increased importance where toxic dusts and vapors or very small droplets are prevalent or where application is in confined spaces. Respiratory hazards are greater when low volume equipment is used, as opposed to conventional application equipment producing large droplets. Pesticides inhaled in sufficient quantities may cause serious damage or irritation to nose, throat, and lung tissues.

3. Oral Route

Pesticides taken through the mouth in amounts sufficient to cause serious injury or death occur by accident or by intent to do self-inflicted injury. The most frequent cases of accidental ingestions are those in which chemicals have been put in unlabeled bottles of food containers or stored where children or irresponsible adults may consume them.

The most serious oral exposure for a pesticide applicator may be caused by splashing of liquid concentrate into the mouth while pouring and measuring pesticides, wiping the mouth with contaminated arms, by attempting to blow out clogged spray nozzles with the mouth, or by eating, smoking or drinking while hands are contaminated.

4. Wound, Cuts, Abrasions, and Burns Route

Any break in the skin may allow a direct route of entry into the blood stream. Even the removal of the outer layer of dead cells of the skin by scraping or scratching may increase the potential for skin absorption. Burns, dermatitis, and eczema resulting from chemical exposure may also enhance the absorption of chemical through the skin.

FIGURE 3

Percent Absorption of Applied Dose of Parathion

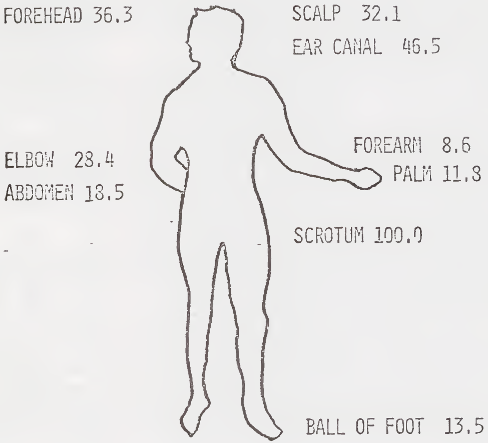


Table 3

Exposure Hazard To Body Parts

Body Parts	Hazard
Lower trunk, legs and feet	Spillage of liquid concentrate or concentrate-wettable powder formulations. Drift, especially from hand spray gun applications.
Upper trunk and arms	Pesticides deposited upon the skin from drift or drip when spray is projected up into trees or onto the air. Upper back, shoulders and forearms of workers shows the greatest potential contamination from this hazard.
Head and neck areas	Head and neck areas are the least protected from downward drift of pesticide particles. Wiping the mouth with contaminated hands can also contaminate the skin.
Hands	Hands represent the highest exposure to pesticides and the greatest chance of coming in contact with concentrated formulations. High potential for cuts or abrasions on hands allows chemical to become more directly absorbed.
Feet	Spillage of liquid on shoes presents a potential for chemical to penetrate improper foot wear (leather boots) and come in contact with the feet.

CHAPTER VI

PROTECTIVE PESTICIDE EQUIPMENT

The best insurance against poisoning by pesticides is to protect the routes by which these chemicals enter the body: oral, dermal, respiratory, and through cuts and abrasions. Good protection requires the routine use of respiratory protective devices, dermal protective garments and sound practices of personal hygiene.

There is a wide variety of protective equipment available ranging in the quality of protection afforded to the pesticide user. The proper selection and use of this equipment largely depends upon the applicator's judgment regarding toxicity, hazards, types of spray equipment employed, and type of work environment.

A. DERMAL PROTECTIVE EQUIPMENT

1. Impermeable Cloth

This clothing should be used when there is a potential for spill of concentrated materials, heavy drift which may saturate clothing, or prolonged exposure to light drift. Heavy gauze material should be selected rather than light if there is a potential for tearing the clothing. This clothing is often made of rubber, neoprene, or polyvinyl chloride bonded to some type of woven fabric.

2. Heavy Grade Cloth Coveralls

These coveralls should be one piece, heavy grade cotton with a tight weave. Cotton coveralls afford a reasonable degree of protection in most spray operations. They should be changed when noticeably wet and washed after each day's use in a strong detergent wash. Coveralls should not be worn where spills of concentrated pesticide may occur.

3. Paper Jackets and Paper Coveralls

These coveralls have been tested and are suitable for use only under conditions where heavy wetting does not occur and under conditions not conducive to tearing of the material.

4. Gloves

Unlined, impermeable gauntlet gloves provide the best protection. Heavy weight gloves, although more durable, do not allow suitable freedom of movement, especially finger dexterity. An applicator may be more inclined to remove this type of glove when cleaning nozzles and adjusting equipment. Additionally, heavy weight gloves are more difficult to turn inside out to clean. Cloth lining can become contaminated and is not easily cleaned. On the other hand, light weight gloves wear out easily. If light weight gloves are used, they should be frequently checked for pinholes and breaks. Gloves should be selected which are durable and provide a reasonable amount of finger dexterity.

5. Head and Neck Covering

Several types of head gear are available to protect the head, neck and hair from pesticide drift. Head gear should be impermeable (waterproof), easily washed, capable of withstanding harsh detergents, and should provide protection to the ears and neck areas from downward drift. Broad brimmed, waterproof rainhats, waterproof hoods or certain types of tight fitting helmets are recommended.

Under no conditions should old felt or similar type hat be used in lieu of waterproof hats. They absorb pesticides, especially in the sweat band, and thereby provide continuous skin contact.

6. Goggles

Good, effective non-fogging goggles are readily available and should be worn when there is a chance of chemical contact with the eye. Goggles increase the amount of facial protection when used with halfmask respirators.

NOTE: All protective clothing and clothes worn under them should be scrupulously cleaned in hot, soapy water after each day's use. When contaminated clothing is worn, this allows the pesticide to penetrate the clothing and come in contact with the skin. This characteristic takes on added importance on hot days, when the rate of skin absorption increases. Applicators in some cases do not put on protective clothing until they begin to feel the drift. By this time, there may be considerable chemical deposited upon the skin or regular clothing. By putting on impermeable clothing over already contaminated clothing or skin, conditions which tend to increase skin absorption may be created.

B. APPROVED RESPIRATORY PROTECTIVE EQUIPMENT

Only those respiratory protective devices designed, approved, or accepted against the particular hazard should be used for respiratory protection. For protection from pesticides, the use of respirators should be limited to those approved by the U.S. Department of the Interior, Mining Enforcement and Safety Administration of the U.S. Department of Health, Education and Welfare, Center for Disease Control, National Institute for Occupation Safety and Health.

1. Classification, Description & Limitations of Pesticide Respiratory Protection Devices

There are three basic kinds of respiratory devices for protection against pesticides. The most commonly used are the chemical cartridge respirators (referred to hereafter as respirators) and gas masks. The third type comprise a combination atmosphere-supplying and air-purifying respirator.

a. Respirators

Most respirators are designed as a half-mask face piece that covers the nose and the mouth, but do not protect the eyes nor provide full facial protection. Several manufacturers have available a combination half-mask face piece respirator and goggle system which provides excellent facial fit and affords increased facial protection.

b. Gas Mask

Gas masks usually cover the entire face and may have either a twin eye or wide vision face piece. Face pieces are made to hold a canister directly (chin style) or are connected to the canister with a flexible hose (chest or back style). Hose type canisters are secured on the chest or back by means of straps. Gas masks are also equipped with an exhaust valve to direct moisture-laden breath out of the mask before it condenses on the lens or in the canister.

c. Self-Contained Respirators

Combination atmosphere supplying and air purifying respirators have a combination blower-filter with a breathing hose leading to a helmet with a plexiglass shield worn by the operator. The unit supplies purified air which is passed through a series of filters and a charcoal absorbing unit for removing dust and spray particles and insecticide vapors. Units for mounting on tractors, back packs, or on equipment for application of pesticides are available for operation on a 6 to 24 volt direct or 150 volt alternating currents.

d. Cartridges

Respirator cartridges usually contain an absorbing material, such as activated carbon or weatherized carbon. Both absorbing materials pick up organic vapors. The activated carbon cartridges will not pick up acid gases (e.g. hydrocyanic acid gas). Accompanying pre-filters remove particulate contaminants, prolonging the life of the absorbing material.

e. Canisters

Gas mask canisters always contain more absorbing material and filter area with longer life than respirator cartridges. The volume of chemical absorbing cartridges in gas mask canisters ranges from 50 to 100 milliliters for chest style canisters. Cartridges and chin style canisters have a shorter useful life than chest or back canisters because of their smaller volume of absorbing materials. The period of effectiveness for respiratory devices is not only dependent upon canister and cartridge size, but also upon the concentration of the contaminant, the wearer's respiratory rate, temperature, humidity, and volume of breathing. High humidity shortens the life of cartridges and canisters in use and in storage. Mists, sprays of water, and rain reduce the effective period of these units. Tests have shown that cartridges and canisters in storage will gradually lose their effectiveness because of the exchange of air due to changes in temperature and atmosphere.

Respirators are limited to low concentrations of gases and vapors and should only be used when applying fine sprays or mists of moderate or low toxicity. Gas masks are designed for high concentrations of gases and vapors over relatively short periods of time and should be used for highly toxic pesticides applied as sprays, mists, or dusts.

2. Use and Selection of Respiratory Protective Devices

Pesticide respiratory devices should be used in strict compliance with their manufacturer's recommendation. Information should be requested from the manufacturer regarding use, maintenance, and limitations prior to or upon purchase of a respiratory protective device. Selection of a respiratory protective device must be based upon the various hazards that may exist in a given operation.

Because of the difference in their protective capacities, selection of proper respiratory devices requires consideration of the following factors:

a. nature of the hazard,

b. extent of the hazard,

c. work requirements and conditions,

d. characteristics and limitations of available respiratory protective devices.

All pesticides are regarded as immediately dangerous to life or health. Under most application procedures, respiratory protection against these toxic substances is accomplished with the use of respirators and/or gas masks with both chemical and mechanical filters. Because of the difference in their protective capacity, GAS MASKS and not respirators should be worn when:

a. pesticides are formulated,

b. pouring concentrated pesticides into a sprayer tank,

c. operators are exposed directly to concentrated dusts, sprays, or aerosols, as in greenhouses, indoors, or operating concentrate air blast machines.

For comfort on hot days during the application of concentrated sprays in citrus groves or fruit orchards, there is available a half-mask face piece equipped with a regular gas mask canister. To protect the eyes under these conditions, non-fogging, non-perforated goggles which fit tightly should be used.

Respirators will give adequate protection to airplane pilots during normal spraying operations, but gas masks are essential with high concentrations of the more toxic pesticides. Pilots may find that the atmosphere-supplying and air purifying respirator is more desirable as it delivers purified air for breathing. If pilots choose to use a half-face piece respirator, non-perforated goggles that give a tight seal around the nose piece should be selected.

When applying grain fumigants, a full-piece gas mask equipped with tested canisters should be worn while pouring concentrated fumigating material directly on the surface of grains. Very high concentrations of gas may be close to the air inlet of the gas mask canister. The concentration of the gas in the intake air may be reduced by mounting the canister on the applicator's back.

A hose mask with blower or a self-contained air supply unit must be used when fumigating below the surface in grain elevators where there is little exchange of air. The hose mask is connected to an air source free of the toxic material or to compressed air cylinder.

Most herbicides in use are often regarded as nontoxic to humans. On the contrary, herbicides may be toxic, irritating or corrosive in their actions and therefore may present a significant health and respiratory hazard. A minimum requirement for respiratory protection against herbicides such as 2,4-D is a mechanical filter to trap mists and coarse spray droplets. Herbicides such as endothall or the dinitro compounds definitely require a mechanical-chemical filter respirator approved for protection for organic vapors.

Newer carbamate herbicides (examples are Carbyne, Avadex, Chem-Hoe) are cholinesterase inhibitors similar to organophosphate insecticides. Adequate protection from these herbicides should also be provided through the use of respirators equipped with both chemical and mechanical filters.

In 1964, the USDA evaluated respirators for various pesticides, however, this list is small in comparison with the number of pesticides on the market (refer to Tables 4 and 5).

3. Training and Education in Proper Use of Respirators

For safe use of any respirator, it is essential that the user be properly instructed in its selection, use and maintenance. All employees should receive instructions from their supervisors. Minimum training should include the following:

a. Instruction in the nature of the hazard, whether acute, chronic, or both, and an honest appraisal of what may happen if the respirator is not used.

b. A discussion of why this is the proper type of respirator for the particular purpose.

c. A discussion of the respirator's capabilities and limitations.

d. Instructions and training in the actual use of a respirator and close supervision to assure that it continues to be properly used.

e. Other special training is needed for special uses of work conditions. Training should provide the user the opportunity to handle the respirator, have it fit properly, and tested for facial seal.

4. Face Piece Fit Tests

A good face piece fit is essential for effective respiratory protection with respirators and gas masks. A good face seal is hindered by such conditions as growth of a beard, sideburns, temple pieces on glasses, and skull caps which project under the face piece. The face piece fit should be checked by the wearer each time he puts on the respirator. This may be done by following the manufacturer's face piece fitting instructions as follows:

a. Positive Pressure Test

Close the exhalation valve and exhale gently into the face piece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the face piece without any evidence of outward leakage of air at the seal. For most respirators, this method of leak testing requires that the wearer first remove the exhalation valve cover and then carefully replace it after the test.

b. Negative Pressure Test

Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing with a seal(s). Inhale gently so that the face piece collapses slightly and hold the breath for ten seconds. If the face piece remains in a slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is probably satisfactory. A respirator should be fitted properly on the face with the narrow part over the bridge of the nose and the chin cup contacting the under side of the chin. Head bands should be adjusted to insure a good seal.

Assistance in training and education in public health and safety aspects of pesticides is available upon request through the Montana Department of Health and Environmental Sciences, Environmental Sciences Division, Food and Consumer Safety Bureau, Vector Control Program, Helena, Montana, 59620, phone number (406) 444-2408 and the Montana Department of Agriculture Environmental Management Division, Helena, Montana, 59620, phone number (406) 444-2944.

5. Maintenance and Care of Respirators

The proper maintenance and care of respirators should include the following basic services:

a. Inspection for defects,

b. Cleaning and disinfecting,

c. Repair,

d. Storage.

Equipment which is properly maintained will provide effective protection and will provide longer lasting service.

Respiratory protective devices should be inspected routinely before and after each use. Inspection should include a check of tightness of connections and conditions of the face piece, head bands, valves, connecting tube, and canisters. Rubber and elastic straps should be inspected for pliability and signs of deterioration. Rubber and elastic parts can be kept pliable and flexible during storage by routinely applying a massaging action. Respiratory devices should be cleaned after each day's use. Prior to cleaning, any filters, cartridges, or canisters should be removed. The face piece and breathing tube should be washed with warm, soapy water, rinsed in fresh water to remove all traces of soap, and sanitized. A residual of sanitizing agent may cause skin irritation and cause accelerated aging of the rubber components. Therefore, a thorough rinsing should accompany the use of a sanitizing agent. For complete decontamination from organophosphate insecticides, the face piece should be washed in a mild detergent solution and rinsed with isopropyl alcohol (rubbing alcohol).

Respirators should be air dried in a clean area separate from pesticide storage or other possible pesticide sources. At this time, valves, straps and other parts can be inspected and defective parts replaced.

The respiratory device, filters, and cartridges should be stored in a clean, cool, dry place, preferably in a plastic bag or container.

When using a respirator, (e.g. dual cartridge with filter) the cloth filter should be changed twice a day or more often if breathing becomes difficult. Cartridges should be changed after eight hours of actual use or more often if an odor of the pesticide is detected.

Manufacturers recommend that exhausted gas mask containers be replaced as soon as gas leakage is detected, as indicated by odor, taste, or eye, nose, or throat irritation.

The U.S. Bureau of Mines stipulates the life of a gas mask canister to be one-half hour when the device is worn by a man performing moderate exercise in gas concentrations up to 2%. The life of a canister will vary according to the concentrations encountered (e.g. one hour for one percent).

6. Special Problems with Corrective Lenses

Respiratory protection for individuals wearing corrective glasses is a serious problem. A tight seal cannot be established if the temple bars of eyeglasses extend through the sealing edge of the full face piece. A temporary solution is to tape glasses with short temple bars to the wear's head. Contact lenses should not be used in a contaminated atmosphere with a half-face piece respirator.

Table 4

List of Respirators and Gas-Mask Canisters

Respirators with Face-Mounted Cartridges

J. C-241 Respirators, with CMP cartridge and C241-7 filter. (Pulmosan Equipment Corp.)

L. Respirator No. 6058, equipped with combination filter-cartridge R-58. (American Optical Co., Safety Division) Also sold by Sears, Roebuck & Co. as Cat. No. 9K1857, cartridge No. 9K18575)

O. Agritox Respirator, equipped with cartridge 11P and filter R553. (Willson Products Division, The Electric Storage Batter Co.)

P. Protex Respirator, equipped with 7500-21 cartridge and 7500-23 filter. (Welsh Manufacturing Co.)

R. Farm Spray Respirator (improved) No. 93938, equipped with No. 93939 GMP combination filter-cartridge. (Mine Safety Appliances Co.)

Supplied-Air Respirators

a. Whitecap System model 250, including No. 4002 helmet assembly with rubberized shroud, No. 1801 cartridge, No. 1603 filter element, and No. 1731 extra fine filter element. (Rite Hardware Manufacturing Co.)

Gas-Mask Canisters

1. Chin Style 282-OVAG-R Insecticide Canister. (Acme Protection Equipment.)*
3. Canister G3FD. (Willson Products Div., The Electric Storage Battery Co.)
4. Universal-type canister, Type N. bearing Bureau of Mines approval for toxic smokes.*
   BM-1436 (Acme Protection Equipment Co.)
   BM-14F-66 (Mine Safety Appliances Co.)
   BM-1445 (Willson Products Division, The Electric Storage Battery Co.)
   BM-1448 (Davis Emergency Equipment Co.)
5. Canister No. 084 OVAG-R (Large size). (Acme Protection Equipment Co.)*
6. Canister No. MH3FC, Chin Style, (Willson Products Division, The Electric Storage Battery Co.)*
7. Canister No. 3229 Type C-4. (Davis Emergency Equipment Co.)
9. Canister GMP, Chin Style, Cat. No. 88180. (Mine Safety Equipment Co.)*

* These canisters are equipped with smoke filters. Do not use other canisters for smokes.

TABLE 5

Respirators and gas-mask canisters that will protect against dusts, mists, and low vapor concentration of certain pesticides. (Refer to Table 4 for corresponding letter and number designations.)

+ Approved
o Not tested to date for approval

Pesticides and pesticide mixtures	Respirators With Face Mounted Cartridges					Supplied-Air Respirators	Gas-mask Canisters							
	J	L	O	P	R	a	1	3	4	5	6	7	8	9
aldrin	+	+	+	+	+	o	+	+	+	+	+	+	+	+
Bayer 39007 (o-isopropoxyphenyl methylcarbamate)	o	+	+	+	o	o	+	o	o	o	o	o	o	o
Bidrin^R (3-hydroxy-N,N-dimethyl-cis-crotonamide dimethyl phosphate)														
calcium copper chloride	+	+	+	+	+	+	+	+	+	+	+	+	+	+
carbaryl (Sevin)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
carbophenothion (Trithion)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ceresan^R M (N(ethylmercuri)-p-tolueneusulfonanilide)	+	+	+	+	o	+	+	+	+	+	+	+	+	+
chlordane	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ciodrin^R (alpha-methylbenzyl 3-hydroxycrotonate dimethyl phosphate)	+	+	+	+	o	o	+	o	o	o	o	o	o	+
D-D^R (dichloropropane-dichloropropene mixture)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
demeton	+	+	+	+	+	+	+	+	+	+	+	+	+	+
diazinon	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dicapthon	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dichlorovos (DDVP)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dieldrin	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dimethoate	+	+	+	+	+	+	+	+	+	+	+	+	+	+
dioxathion (Delnav)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Di-Syston^R (O,O-diethyl S-[2-ethylthio) ethyl] phosphorodithioate).	+	+	+	+	+	+	+	+	+	+	+	+	+	+

Table 5 (continued)

Pesticides and pesticide mixtures	Respirators With Face Mounted Cartridges					Supplied-air Respirators	Gas-mask Canisters							
	J	L	O	P	R	a	1	3	4	5	6	7	8	9
endosulfan (Thiodan)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
endrin	+	+	+	+	+	+	+	+	+	+	+	+	+	+
EPN	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ethion	+	+	+	+	+	+	+	+	+	+	+	+	+	+
ethylene dibromide	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Ethyl Guthion^{R} (O,O-diethyl S(4-oxo-1,2,3-benzotriazin-3(4H)-ylmethyl) phosphorodithioate)	+	+	+	+	+	o	+	o	o	o	o	o	o	o
ferbam	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Guthion^{R} (O,O-diethyl S-(4-oxo-1,2,3-3(4H)-ylmethyl phosphorodithioate)	+	+	+	+	+	o	+	o	o	o	o	o	o	o
Kepone^{R} (decachlorooctahydro-1,3,4-metheno-2H cyclobuta [cd] penetalen-2-one)	+	+	+	+	+	o	o	o	o	o	o	o	o	o
lindane	+	+	+	+	+	o	o	o	o	o	o	o	o	o
malathion	+	+	+	+	+	+	+	+	+	+	+	+	+	+
methyl parathion	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Methyl Trithion^{R} S-(p-chlorophenylthio) methyl O,O-dimethyl phosphorodiathioate.	+	+	+	+	+	+	+	+	+	+	+	+	+	+
mevinphos (Phosdrin)	+	+	+	+	o	o	+	o	+	+	+	o	o	o
naled emulsion (Dibrom)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
naled xylene solution (Dibrom)	+	+	+	o	o	+	+	o	+	+	+	+	o	o
nicotine	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Panogen^{R} (cyano(methylmercuri)guanidine	+	+	+	+	+	+	+	+	+	+	+	+	+	+
parathion	+	+	+	+	+	+	+	+	+	+	+	+	+	+
phorate	+	+	+	+	+	+	+	+	+	+	+	+	+	+
phosphamidon	+	+	+	+	+	o	+	o	o	o	o	o	o	o
Phostex^{R} (a mixture of bis(dialkloxyphosphinothioyl) disulfides (alkyl ration 75% ethyl, 25% isopropyl)	+	+	+	+	+	+	+	+	+	+	+	+	+	+

TABLE 5 (continued)

Pesticides and pesticide mixtures	Respirators With Face-Mounted Cartridges					Supplied-air Respirators	Gas-mask Canisters							
	J	L	O	P	R	a	1	3	4	5	6	7	8	9
ronnel	+	+	+	+	+	+	+	+	+	+	+	+	+	+
schradan	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Shell Compound 4072 (2-chloro1-(2,4-dichlorophenyl)vinyl diethyl phosphate)	+	+	+	+	+	o	+	o	o	o	o	o	o	o
Telodrin^R (1,3,4,5,6,7,8,8-octachloro-1,3,3a,4,7,-7a, hexahydro-4,7-methanoisobenzofuran)	+	+	+	+	+	o								
tepp	+	+	+	+	+	+	+	+	+	+	+	+	o	+
Terraclor^R (pentachloronitrobenzene)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Vapam^R (sodium N-methyldithiocarbamate)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Zectran^R (4-dimethylamino-3,5-sylyl methylcarbamate)	+	o	o	+	o	o	+	+	+	+	+	+	+	+
zineb	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Zinophos (O,O-diethyl O-2-pyrazinyl phosphorothioate)	+	+	+	+	+	+	+	+	+	+	+	+	+	+
carbophenothion + methyl parathion + DDT	+	+	+	o	+	o	+	o	o	o	o	o	o	+
DDVP + malathion	+	+	+	+	o	o	+	+	+	+	+	+	+	+
DDVP + ronnel	+	+	+	+	o	o	+	+	+	+	+	+	+	+
Guthion^R + ethyl Guthion^R	+	+	+	+	+	o	+	o	o	o	o	o	o	o
methyl parathion + endrin	+	+	+	+	o	o	+	o	+	+	+	o	o	+
Methyl Trithion^R + DDT	+	+	+	+	+	o	+	+	+	+	+	+	+	+
toxaphene, DDT, methyl parathion + ethion	+	+	+	+	+	o	+	+	+	+	+	+	+	+

CHAPTER VII

FIRST AID IN THE EVENT OF PESTICIDE POISONING

A. FIRST AID

If You Are Alone With The Victim

First --- See that the victim is breathing; if not, give artificial respiration.

Second -- Decontaminate him immediately, i.e. wash him off thoroughly. Speed is essential!

Third --- Call your physician.

NOTE: Do not substitute first aid for professional treatment. First aid is only to relieve the patient before medical help is reached.

If Another Person Is With You and The Victim

1. Speed is essential; one person should begin first aid treatment while the other calls a physician.

The physician will give you instruction. He will very likely tell you to get the victim to the emergency room of a hospital. The equipment needed for proper treatment is there. Only if this is impossible should the physician be called to the site of the accident.

2. General Treatment

a. Give mouth-to-mouth artificial respiration if breathing has stopped or is labored.

b. Stop exposure to the poison and if poison is on the skin, cleanse the person, including hair and fingernails. If pesticide is a powder, brush it away do not wash with water. If swallowed, induce vomiting.

c. Save the pesticide container and material in it, if any remains; get a readable label which containes the name of chemical for the physician. If the poison is not known, save a sample of the vomitus.

3. Specific Treatment

a. Poison on Skin:

(1) Drench skin and clothing with water (shower, hose, faucet),

(2) Remove clothing,

(3) Cleanse skin and hair thoroughly with soap and water (rapidity in washing is most important in reducing extent of injury)

(4) Dry and wrap in blanket.

b. Poison in Eye:

(1) Hold eyelids open, wash eyes with gentle stream of clean running water immediately. Use copious (large) amounts. Delay of a few seconds greatly increases extent of injury,

(2) Continue washing for 15 minutes or more,

(3) Do not use chemicals or drugs (i.e. commercial eye washes) in wash water. They may increase the extent of injury

c. Inhaled Poisons (Dusts, Vapors, Gases):

(1) If victim is in enclosed space, do not go in after him without air supplied respirator,

(2) Carry patient (do not let him walk) to fresh air immediately,

(3) Loosen all tight clothing,

(4) Apply artificial respiration if breathing has stopped or is irregular,

(5) Call a physician,

(6) Prevent chilling (wrap patient in blankets but don't overheat him),

(7) Keep patient as quiet as possible,

(8) If patient is convulsing, watch his breathing and protect him from falling and striking his head. Keep his chin up, and the maneuver keep the air passage will free for breathing,

(9) Do not give alcohol in any form.

d. Swallowed Poisons:

(1) Call a physician immediately,

(2) Do not induce vomiting if:

(i) Patient is in a coma or unconscious.

(ii) Patient is having convulsions.

(iii) Patient has swallowed petroleum products (that is, kerosene, gasoline, lighter fluid).

(iv) Patient has swallowed a corrosive poison (strong acid or alkaline products); symptoms: severe pain, burning sensation in mouth and throat.

(3) If the patient can swallow after ingesting a corrosive poison, (a corrosive substance is any material which in contact with living tissue will cause destruction of tissue by chemical action such as lye, acids, Lysol, etc.) give the following substances by mouth:

(i) For Acids: milk, water, or milk of magnesia (1 tablespoon to 1 cup of water),

(ii) For Alkali: milk or water; for patients 1-5 years old, 1 to 2 cups; for patients 5 years and older, up to 1 quart.

(4) If possible, induce vomiting when noncorrosive substance has been swallowed.

(i) Give milk or water (for patients 1-5 years old, 1 to 2 cups; for patients over 5 years, up to 1 quart),

(ii) Induce vomiting by placing the blunt end of a spoon, not the handle, or your finger at the back of the patient's throat, or by use of this emetic - 2 tablespoons of salt in a glass of warm water,

(iii) When twitching and vomiting begin, place patient face down with head lowered, thus preventing vomitus from entering the lungs and causing further damage. Do not let him lie on his back,

(iv) Do not waste excessive time in inducing vomiting if the hospital is a long distance away. It is better to spend the time getting the patient to the hospital where drugs can be administered to induce vomiting and/or stomach pumps are available,

(v) Clean vomitus from person. Collect some in case the physician needs it for chemical tests.

e. Chemical Burns of Skin:

(1) Wash with large quantities of running water,

(2) Remove contaminated clothing,

(3) Immediately cover with loosely applied clean cloth, any kind will do, depending on the size of the area burned,

(4) Avoid use of ointments, greases, powders, and other drugs in first aid treatment of burns,

(5) Treat shock by keeping patient flat, keeping him warm, and reassuring him until arrival of physician.

B. POISON CONTROL CENTERS

In Montana the Poison Control System telephone number is 1-800-525-5042. The Emergency Medical Services Bureau (EMS) of the Montana Department of Health and Environmental Sciences located in the Cogswell Building in Helena (59620) will provide telephone stickers with the Poison Control phone number free of charge.

CHAPTER VIII

PESTICIDES AND THE ENVIRONMENT

A. ENVIRONMENTAL FATE

To minimize the side effects of pesticides, it is important to understand their fate in the environment. Many pesticides are harmful to wildlife, plants, and other organisms if misapplied. Most pesticides are not specific in action; they affect organisms other than the target pest. Some pesticides with harmful effects to the environment have been removed from registration. For example, many organochlorine insecticides, such as DDT, persisted for years in the environment and were suspended from registration.

In addition to immediate toxic effects to pests and other organisms, pesticides may remain in the environment for varying periods of time. These chemicals may accumulate in soils and animal tissues. For example, the insecticide DDT was removed from registration in 1972 but traces can still be found in soils, water, and animal tissues. To understand the actions of pesticides in the environment, it is necessary to discuss residues and tolerances.

1. Residues

A residue is that portion of any pesticide or its breakdown products remaining in or on soil, air, water, plants, and animals at any point in time. The amount of residue that can be measured is related to persistence, or the length of time the pesticide and its metabolites (breakdown products) remain in the environment. All pesticide applications result in residues remaining in the environment for varying lengths of time, however, the environmental "life" of a residue varies according to its persistence. Pesticides of the organochlorine group (DDT, Aldrin, Dieldrin, and Endrin) are quite persistent and their residues usually last for years. Malathion, diazinon, and carbamates (Sevin) are examples of less persistent pesticides that break down more rapidly.

In addition to the pesticide type, breakdown is influenced by other factors including soil types, weather, application rates, and sunlight. For example, Temik, an insecticide applied in the soil, breaks down quicker in sandy than in clay soil.

Residues are commonly expressed in terms of parts per million (ppm) by weight. Advances in research techniques have made it possible to detect certain pesticides at levels approaching 0.001 ppm which is one part per billion. To illustrate size, 1 ppm is less than 1 teaspoon in 1000 gallons.

2. Tolerance

A residue tolerance or "tolerance level" is simply the legal amount of residue allowable in or on a raw agricultural commodity. Tolerances are established in parts per million by weight and are specific for each pesticide and crop. Tolerances are established by the Environmental Protection Agency (EPA). Washing and scrubbing of fruit and vegetables and various food processing procedures such as peeling and cooking can reduce the amount of residue remaining on food prior to consumption.

Pesticides applied in accordance with directions printed on the label should not result in residues that exceed the legal tolerances. Pesticide labels list "time intervals" required between the date of application and harvest, milking, slaughter, or reentry onto the premises. Violation of these time intervals can result in illegal residue levels for commodities or may present a hazard to workers.

Changes occurring in commodities may serve to increase or decrease residue problems. The loss of water through dehydration of commodities (fruit) may result in an increase in the percent of residue present. Since residues are measured on a weight basis, the removal of water makes the product lighter and the ratio of chemical residue to the weight of the commodity is altered. This difference is sometimes great enough to exceed legal tolerances.

B. ENVIRONMENTAL CONTAMINATION BY PESTICIDES

Pesticides may be found throughout the environment in soils, air, agriculture commodities, living spaces, and fish and wildlife. Residues from some of the more persistent compounds have been found in human tissues.

As an example of non-target contamination, consider an application of a persistent pesticide to winter wheat. Depending on environmental and crop conditions at the time of application, one might expect any of the following pesticide movements:

Movement of pesticide by drift to off-target biota, water, and soil,

Movement of pesticide residues in grains to food processing centers and feed lots or to wildlife,

Movement into the water or other soils by runoff, leaching, or direct application, or

Movement on contaminated farm machinery.

1. Pesticides in the Air

The major source of air pollution by pesticides is through direct ground and aerial application. The amount of pesticides which enters the atmosphere is determined by wind, temperature inversions, pesticide formulation, particle size, drift of the compound, and type of compound applied.

Pesticides have become part of the general atmospheric circulation and are transported over vast areas. A national pesticide air monitoring program is being conducted by EPA to determine the pesticide burden on the atmosphere and its effect on man's total exposure to pesticides. The National Pesticides Air Monitoring Program collected 1850 ambient air samples in the 48 contiguous states and the Bahamas from 1970 through 1971. Measurable amounts of twenty-one different organochlorine pesticide residues, eleven different organophosphate pesticide residues, and esters of two chlorophenoxy acid pesticides and Azadrin were identified over the two year period. DDT was identified at all sample sites in both 1970 and 1971. Quantities identified did not approach the allowable daily intake levels established for humans.

Although the pesticide burden of the general circulating atmosphere does not appear to pose any serious environmental dangers, drift from both aerial and ground applications of pesticides has resulted in significant economic and environmental losses. A number of incidents occur each year in Montana involving drift of potent phenoxy herbicides from ground and aerial applications. These incidents often cause non-target crop and plant damage.

Poisonings occurred in Toppenish, Washington following the aerial dusting of hop vines with tetraethyl pyrophosphate (TEPP) in which the dust cloud drifted at least 700 feet beyond the vineyards over adjacent pastures, crops, and homes. The dust hung in the air as a cloud about three feet above the ground and did not lift or move for almost two hours. Fifteen (15) people in the area experienced poisoning symptoms and recovered within a few hours. Cattle in the immediate vicinity showed severe symptoms and two heifers died.

Pesticides, when applied to vegetation, may vaporize before they reach the vegetation or while they are drying upon the vegetation. Vaporization of pesticides is a continuous process affected by certain variables such as freezing weather and spray particle size and is a contributing factor to air pollution.

2. Pesticides in Water

Pesticides enter the water by routes such as direct application to aquatic pests, drift, runoff, leaching, and by improper disposal. Water contaminated with pesticides from these sources may directly or indirectly affect human health, domestic and wild animals, and crops.

Many pesticides have a low water solubility and are rapidly "tied up" with suspended materials or in sediment. Subsequently, the fraction of pesticide in the water after the initial contamination may diminish as pesticides become tied to particles. Breakdown in sediments may proceed slowly and pesticides or breakdown products may be released into streams. In lakes and ponds, pesticides may remain in the sediments for years.

3. Public Drinking Water Standards

The Public Health Service has established drinking water standards for these groups of pesticides: organochlorines, herbicides, and cholinesterase inhibiting compounds. These standards are the levels which, if ingested over extended periods of time, will not cause harmful or adverse physiological changes in man. For some pesticides, such as Parathion, lower than physiologically safe levels were adopted to prevent tastes and odors. All standards have been adopted into the Montana Water Pollution Laws, Water Quality Standards.

Contamination of public drinking waters may occur from spillage of pesticides near an improperly or poorly constructed well, back siphonage resulting from the lack of an air gap or a properly functioning backflow prevention device, the improper application of chemicals in or near waters used for drinking, or improper disposal of pesticides.

4. Livestock Ponds

September, 1978 estimates by the A.S.C.S. place the number of farm ponds in Montana in excess of 38,000. Although their primary purpose is the watering of livestock, stock ponds provide habitat for a variety of wildlife, recreational areas for hunting and fishing, and sources of secondary income such as commercial trout fisheries. Pesticides may enter ponds through drainage, by drift or misapplication. In addition to harmful effects on aquatic life, residues may appear in meat or milk.

5. Irrigation Water Supplies

Pesticides can be transported in irrigation ditches to non-target areas and organisms. Misapplications of aquatic herbicides in Montana have contaminated streams and resulted in deaths of fish and other aquatic life. The phenoxy herbicide 2,4-D has been a frequent contaminant of irrigation waters.

6. Ground Waters

Studies indicate that the pesticides may contaminate ground water. Local geological conditions and improper disposal influence ground water contamination in the United States. Contamination of ground water presents a threat to human health. Current EPA studies show ground water contamination of several insecticides and some herbicides including temik, 2,4-D and picloram.

7. Pesticides in Montana Waters

In the late 1930's, the first substantiated report of pesticides in water occurred when Yellowstone River was contaminated by arsenic. Fish and aquatic life were eradicated in a section of the river. Because the arsenic was diluted, no serious problems were experienced in public water supplies. Since that time, many other pesticide pollution problems have occurred. Each year there are three or four reports of wells being contaminated with pesticides. In most cases, the pesticides are 2,4-D formulations. Generally, the only method to correct this problem is to pump the well continually until the pesticide residues are eliminated or are very low.

In the 1960's, the Public Health Service established sampling stations to determine pesticide content in Montana's waters. In 1964, the Big Horn River near Hardin was surveyed for chlorinated hydrocarbon pesticides. Compounds found were Dieldrin at .012 ug/L and Endrin at .026ug/L. DDT and metabolites, Aldrin, Heptachlor, Heptachlor Epoxide, and BHC were not found. The Yellowstone River near Sidney revealed .008ug/L of Dieldrin and .021 ug/L of Endrin. Presently, the Federal Water Quality Administration, now the Environmental Protection Agency, has established several monitoring sited for pesticides in the state:

- Missouri River near Fort Benton,
- Milk River near Glasgow,
- Missouri River near Culbertson,
- Yellowstone River near Corwin Springs,
- Yellowstone River near Laurel,
- Clark Fork of the Yellowstone River near Laurel,
- Yellowstone River near Billings,
- Yellowstone River near Custer,
- Big Horn River near St. Xavier,
- Powder River near Moorhead.

Water samples from these sites are tested for pesticides usually on a quarterly basis. Analysis of samples include all of the following compounds: Aldrin, Lindane, Chlordane, DDD, DDE, DDT, Dieldrin, Endrin, Heptachlor, Heptachlor Epoxide, Malathion, Diazinon, Methyl Paration, 2,4-D, 2,4,5-T and Silvex. DDT and 2,4-D were the compounds usually found.

8. Pesticides in Soil

The effects of pesticides in the soil can be either short or long-term in nature. Factors which help determine persistence of pesticides in the soil are: the chemical characteristics of the pesticide, soil type, moisture and temperature, wind or air movement, vegetation cover, soil cultivation practices, the method of applying the pesticide, the soil micro-organisms, and other physical and chemical factors. The amount of organic matter in soils affects rate of adsorption. Soil permeability and the solubility of a pesticide also affect pesticide adsorption on the soil. Many pesticides are adsorbed to a greater extent at lower temperatures than at higher temperatures. The degradation process usually increases with soils having a high moisture content. Soil temperature affects the breakdown of pesticides and can affect the volatilization of a pesticide. Soil contamination can eventually lead to environmental problems in air, water, animals, and especially plants.

C. BIOLOGICAL MAGNIFICATION

Biological magnification of pesticides refers to the accumulation of pesticides in animal tissues at higher levels in the food chain. The sequence of organisms through which food moves is a food chain. An example of a simple food chain is grain - livestock - man. Pesticides that are stable and not excreted can move through a food chain and become more concentrated in the tissues at each higher level. Figure 4 illustrates biological magnification of DDT, a persistent insecticide.

D. GUIDELINES YOU CAN FOLLOW TO HELP AVOID UNNECESSARY CONTAMINATION OF THE ENVIRONMENT

1. Use pesticides only when there is a definite need for pest control and no feasible alternatives.

2. Be sure that you have a problem that pesticides can correct. Apply them as specific treatments, not as general remedies.

3. Use pesticides only on crops that are being attacked by pests.

4. Do not apply more than needed. A thorough application at recommended dosage rates is more effective than an excessive amount applied in a haphazard fashion.

5. The need to dispose of pesticides can be reduced by mixing only the amount of spray you need.

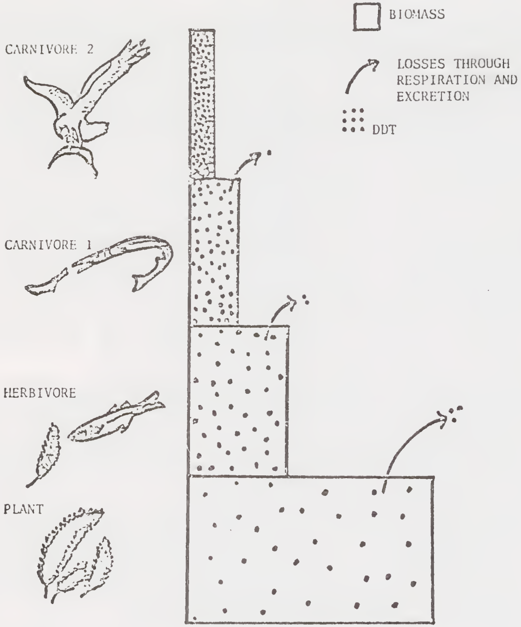
6. Do not drain surplus pesticides into sewage or septic tank systems.

7. Dispose of empty containers properly. Empty containers still contain small amounts of pesticides which can seep into soil or water.

8. Follow all directions on pesticide containers.

9. Be aware of any and all consequences that may develop as a result of an application of a pesticide.

FIGURE 4 - BIOLOGICAL MAGNIFICATION OF DDT



CONCENTRATION of DDT residues being passed along a simple food chain is indicated schematically in this diagram. As "biomass", or living materials, is transferred from one link to another along such a chain, usually more than half of it is consumed in respiration or is excreted (arrows); the remainder forms new biomass. The losses of DDT residues along the chain, on the other hand, are small in proportion to the amount that is transferred from one link to the next. For this reason high concentrations occur in the carnivores.

CHAPTER IX

FISH AND WILDLIFE

Wildlife managers have little control over any of the basic ingredients that make up the wildlife environment. Therefore, they must be critical of practices that alter or affect the environment in which wildlife is produced. Fish and wildlife are among the first non-target animal species noticeably affected by pesticides. Mass application programs over large tracts of land and improper applications (misuse and carelessness) can cause damaging affects to the environment, and consequently to wildlife. Most pesticide problems occur because aspects of ecology are ignored, not understood, or not considered.

A. EVALUATION OF PESTICIDES AND THEIR AFFECTS ON WILDLIFE

Adverse effects of pesticides have triggered studies to determine their impact on wildlife. Results confirm the legitimate concern by fish and wildlife conservation agencies and private citizens for the effects of pesticides on fish and wildlife. This research has defined the toxicity of many pesticides to various species of fish and wildlife. Not all evaluations are complete and extensive testing remains to be done.

Most evaluations now involve penned animal and laboratory experiments and controlled experimental field work. Penned and laboratory experiments are necessary because:

1. They provide controlled facilities for determining lethal levels and side effects of a single compound on a given species,

2. Species in the wild are frequently difficult to obtain during the pesticide use season,

3. Controlled diets prior to pesticide testing minimize confusion with background levels of pesticides previously contacted by wildlife.

B. CLASSIFICATION OF PESTICIDES ACCORDING TO THEIR AFFECTS ON WILDLIFE

Those pesticides that possess high toxicity or are persistent in the environment are of greatest concern to wildlife manager. These are grouped as follows:

1. High direct toxicity

    a. Chlorinated hydrocarbons, such as DDT, Dieldrin, Toxaphene

        1) very high LC_{50} for aquatic fauna,

2) certain formulations have a high LD_{50} on terrestrial fauna,
3) accumulative in food chains.

b. Organophosphorus compounds, such as Parathion, Phosdrin, TEPP

1) very high LC_{50} for aquatic fauna,
2) many formulations have a high LC_{50} to terrestrial fauna, especially birds,
3) some formulations accumulate in food chains.

c. Carbamates, such as Zectran, Baygon

1) low to moderate LC_{50} to aquatic fauna,
2) some formulations have a high LD_{50} to terrestrial fauna, especially birds.

2. Persistent or high residue

a. Chlorinated hydrocarbons,

b. Organophosphorus compounds, and

c. Inorganic compounds incorporating heavy metals such as mercury, lead, and arsenic.

C. EFFECTS OF PESTICIDES ON FISH AND WILDLIFE

1. Direct or Acute Effects

The acutely toxic pesticides (mostly insecticides) poison animals directly upon ingestion or contact. While direct pesticide poisoning of terrestrial wildlife has been documented in several areas in the United States, data is limited in Montana. In a field trial with phosphamidon (organophosphate) applied at a rate of 1 lb/A. on 5,000 acres in a Montana forest against spruce budworm, blue grouse were killed, and other bird activity dropped by about one-quarter of the pre-spray level.

Fish and other aquatic organisms are more influenced by pesticide levels in water than are other organisms. Aquatic life is continuously submersed in water and its associated contaminants, and thus are subjected to the contaminants through their gills and body surfaces as well as in their food.

A number of fish kills have occurred in Montana due to pesticide poisoning. Among those pesticides involved were: Dieldrin, Toxaphene, Lindane, DDT, and various herbicide formulations for aquatic vegetation control. Some of the waters in which kills have occurred are the Yellowstone River, Stillwater River, Red Rock River, Warm Springs Creek near Anaconda, Spring Creek near Choteau, Mill Creek near Frenchtown, Sixteen Mile Creek near Three Forks, Blacktail Creek and the Beaverhead River near Dillon. In the past few years, three fish kills were reported soon after 2,4-D was applied adjacent to bodies of water, but these were not verified by technical personnel. Although most of the above pesticides have been cancelled or suspended by the EPA, many of the currently registered products, if misused, could produce the same results.

Some of the above mentioned kills were caused by dipping or spraying livestock near the water and then allowing the livestock access to streams and ponds. In one instance, the surplus dip was disposed into a stream. Several fish kills have been caused by allowing herbicide treated ditch or canal water to flow back into streams.

2. Delayed Mortality

Mortality of fish and wildlife may not occur until some time after direct exposure to toxic pesticides. A Wyoming experiment indicated adult pheasants did not die until about 20 days after lethal doses of Toxaphene were administered. Field studies have shown virtual elimination of wild turkeys after Heptachlor applications at field rates. Some turkey mortality was still occurring the second year after application. Four months after 300,000 acres of forest land were sprayed with DDT in 1955, large numbers of dead trout, whitefish and suckers appeared over about 90 miles of the Yellowstone River near Livingston. Tissue analysis from fish specimens revealed high levels of DDT.

3. Indirect or Subtle Effects

Pesticides can affect the welfare of fish and wildlife in a variety of ways, other than by mortality through direct exposure. Indirect or subtle effects of pesticides often create conditions that influence wildlife populations over extended periods of time. These conditions are discussed in the following sections.

a. Transport through food organisms

Fish and wildlife can be exposed by eating animals poisoned by pesticides or plants containing pesticides. One study conducted in Montana revealed the mortality rate of trout treated with 1 ppm DDT increased by 13 to 22 percent. Fish not treated, but fed aquatic insects with DDT residues, also experienced increased mortality. This phenomenon could also occur with birds feeding on insects killed with insecticides. Insects are an important portion of the diet of some game and song bird species.

b. Biological magnification

An animal may never be exposed to pesticide applications but ingest enough pesticide in its normal food supply to affect its well being. For example, in an aquatic environment algae and invertebrates may take up minute amounts of a pesticide or its breakdown products and store it in their tissues. These species in turn are consumed by forage fish and these by predatory fish, each storing increasing amounts of residues in their tissue and body fats. In food chain studies, fish-eating predators such as hawks and pelicans (final carnivores) have contained the highest residue levels. Numerous pesticide deaths of robins were attributed to their feeding on earthworms containing high residue levels.

c. Residues stored in body organs and tissues

Reproduction of fish and wildlife can be affected from sublethal doses of pesticides in diets. Pheasants fed sublethal doses of DDT in pre-season breeding diets passed DDT into their egg yolks. Egg fertility or production was not lowered, however, nearly a 50 percent mortality occurred in the chicks within 6 weeks after hatching. Toxaphene and Dieldrin in diets of pheasants have significantly reduced hatching success and caused poor chick survival. DDE, a DDT metabolite, has been demonstrated to cause egg shell thinning in several species of birds, including mallard ducks, brown pelicans, ospreys, and falcons. Osprey population declines in the Flathead Lake area are attributed in part to egg shell thinning caused by DDE in the diets of the birds.

High mortality of coho salmon fry from Lake Michigan occurred from eggs containing significant quantities of DDT, Dieldrin, and polychlorinated biphenyls (PCB's). Another study reported adult fish did not appear to be harmed by low concentrations of Endrin in water; however, their eggs accumulated the Endrin which ultimately affected the developing fry.

Pesticide residues in tissue of wildlife of commercial and sporting value has caused local economic impacts. The Canadian Provinces of Alberta and Saskatchewan restricted gamebird seasons when mercury levels in upland gamebirds exceeded standards adopted for human consumption. Commercial sales of coho salmon and other fish species from Lake Michigan were prohibited in 1967 when DDT residues in tissue exceeded 5 ppm.

Studies have been conducted in Montana to determine pesticide levels in various wildlife species. Results revealed residues were present in wildlife throughout the state. Various species of trout collected from the Yellowstone River above Livingston in 1958 revealed DDT residues as high as 1.52 ppm. Trout, whitefish, goldeye, and suckers collected from the Yellowstone River near Billings contained DDT, DDD, and DDE up to 2.86 ppm. Organochlorine insecticide residues were found in several species of fish collected from the Missouri River near Great Falls in 1967-1968. The most common pesticides found were DDT and its metabolites, Dieldrin, and Heptachlor Epoxide.

In 1970, fish from over twenty bodies of water in Montana were collected and analyzed for mercury. Trace to significant amounts of mercury were found. Mercury in fish from two bodies of water exceeded the FDA recommended tolerance limit of 0.50 ppm. It appears that most mercury contamination of fish can be attributed to pesticides.

Six sampling areas were set up throughout Montana as part of the National Pesticide Monitoring Program to study organochlorine residues in starlings. DDT and its metabolites and Dieldrin were found in all samples. Other residues found were Heptachlor Epoxide, Lindane and BHC.

Hungarian partridges, sharp-tailed grouse and pheasants were collected throughout Montana for mercury analysis. Birds from all regions contained mercury. The highest concentration found in any one bird was 0.53 ppm.

Deer were collected and analyzed for DDT following spray projects in two Montana forests. Nearly all deer collected contained some residues, with the highest at 27 ppm in fat tissue. Fawns collected from one of the forests contained DDT residues in their body fat which would indicate the pesticide was being passed through the mother's milk.

d. Elimination of food sources

Application of pesticides over broad areas eliminates certain food sources depended upon wildlife. Elimination of food sources causes wildlife to shift to other areas, utilize other food sources, or die. Wildlife moving to another area creates additional competition for food and space with resident species. A predatory animal lacking prey may shift to a valued game species or even domestic livestock.

Two studies on southeastern Montana rangelands demonstrated resident bird population declines with no mortality observed following insecticide application.

It was concluded from one of these studies that 50 percent reduction in grasshopper numbers was sufficient to cause insectivorous birds to leave during the nesting season. Control of insects over a large area could affect many bird species since insects are an important protein source for the young.

Several Montana studies have revealed aquatic insect life in streams was drastically lowered after massive forest spraying with insecticides. Some streams did not repopulate to pre-spray levels for nearly two years. The lack of aquatic life affects the resident fish population.

Sage grouse studied in southwestern Montana following a sagebrush spray program preferred unsprayed areas to sprayed areas. The summer diet of the grouse includes about 80 percent sagebrush and dandelions, which were lacking in the sprayed areas. This example indicates that chemical applications over broad areas to selectively controlled vegetation also limits food supplies upon which certain species of wildlife are dependent.

4. Alteration of Wildlife Habitat

Fish and wildlife are dependent upon the habitat in which they are found. If pesticide applications alter specific plant and food items by design or as "innocent victims," the welfare of wildlife may be affected. Pheasant populations in several areas of Montana have been drastically reduced by chemical and mechanical methods to eliminate brushy areas and other cover plants. Sage grouse populations have been reduced in several areas because of chemical control of sagebrush. Herbicide destruction of willow and other riparian vegetation along stream courses not only reduces habitat for birds and other wildlife, but also exposes the streambanks to erosion. Soil erosion decreases water quality in streams which leads to poorer habitats for aquatic life.

In some areas, roadside vegetation offer valuable or the only habitat suitable for wildlife. Roadside spray programs are often detrimental to wildlife because all vegetation is often treated whether or not the target species are present. Since stream banks are particularly crucial fish and wildlife areas, they should not be sprayed within 200 feet of the high water mark.

D. POINTS TO CONSIDER FOR THE WELFARE OF WILDLIFE IN PESTICIDE APPLICATION PROGRAMS

1. The acute toxicity of the pesticide,

2. Persistence of the pesticide in the environment,

3. Volatility and other characteristics of the pesticide and carrier,

4. The target species treated,

5. The season of application,

6. The rate of application,

7. Environmental conditions,

8. Species of wildlife exposed.

Since all pesticides have some degree of hazard to some form of wildlife, the best protection for wildlife is to select an alternative to chemical application, when feasible.

When pesticide use is deemed absolutely necessary, the following recommendations will minimize (not eliminate) the environmental impact:

1. Pesticides causing the least environmental damage should be used.

2. The minimum application rates needed to control the target pest should be strictly adhered to.

3. Insecticides and herbicides should be applied only to known problem sites. Fish and Game biologists can provide local advice for protecting wildlife on specific areas.

4. Surplus pesticides should not be applied on adjacent areas merely for the sake of disposal. They should be safely stored or disposed of in a manner which will not contaminate the environment, in strict accordance with label instructions.

5. Extreme caution must be used when cleaning spray equipment and disposing of pesticide containers to prevent environmental contaminations. The Department of Fish and Game, in conjunction with the Solid Waste Bureau of the Department of Health and Environmental Sciences, will assist in the disposal of pesticide compounds that are no longer used.

6. Spraying during even slight wind conditions can result in considerable pesticide drift and contamination of adjacent, non-target areas, including waterways. Remember, some pesticides are highly toxic to certain aquatic wildlife species, with toxicity measured in ppm.

7. Domestic animals treated with chemicals should not be allowed to contaminate streams and water areas inhabited by fish and wildlife.

8. Extreme care should be taken to avoid contamination of streams when applying chemicals to canals or ponds for aquatic vegetation control. In fact, all pesticides with the label warning, "Do not apply near lakes, ponds, or streams", "This product is toxic to fish", or any other statement implying a hazard to aquatic life, should not be applied within 200 feet of the high water mark of such waters.

9. Pesticide application decisions should reflect the full consideration of human health and fish and wildlife impacts as well as economic considerations.

CHAPTER X

ALTERNATIVES TO CHEMICAL CONTROL

A. ALTERNATIVE CONTROL METHODS

Pesticides offer an easy method for pest control, however, alternatives such as cultural and biological control can help reduce problems associated with constant pesticide use. Some problems resulting from pesticide use are:

1. Environmental contamination; i.e. effects to non-target organisms,

2. Development of pests resist to pesticides,

3. Accidental poisoning of humans of livestock,

4. Effects of long-term exposure.

Alternatives to pesticide use are available. For information on specific problems, contact a County Extension Agent or the Montana Department of Agriculture. Below is a list of common alternatives:

1. Cultural Methods

Common cultural pest control methods include:

a. Sanitation practices may reduce pest populations, overwintering sites, or food supplies. Clean summer fallow helps remove food for such pests as wireworms. Mowing and burning eliminates weeds and decreases sources of reinfestation; it can also eliminate areas where pests such as grasshoppers and leafhoppers increase in numbers before invading crops. Use of clean implements can prevent the introduction of weed seed into clean fields.

b. Crop rotation and adjustment of planting dates can disrupt the relationship between pest and crop. A four year rotation of potatoes with other crops helps control potato blight spores that overwinter in the soil. Fall plantings of grains may help control incidence of stinking smut. Wheat planting dates can be adjusted so that the new seedlings escape the period of time that the Hessian fly lays eggs.

c. Fertilizer application, proper pruning, and adequate irrigation will produce healthier crops which can better resist insects and disease and help the crop compete with weeds.

d. Trap or buffer crops around field margins may attract insect or nematode pests away from the major crop.

e. The use of cleaned seed can help prevent the introduction of weeds.

f. The use of certified seed will help control disease. For example, certified seed potatoes grown in Montana are inspected and tagged only if free of certain virus diseases.

g. Crops resistant to insects and disease can be used. The use of resistant strains of wheat is one of the only effective ways of controlling the Hessian fly. Loose smut can also be controlled by planting resistant varieties.

h. Selection of growing sites can help assure a vigorous crop that can effectively compete with diseases, insects, and weeds.

2. Physical-Mechanical Methods

This method of control includes physical measures which involve manipulating or utilizing certain aspects of the environment, and mechanical measures or the use of machinery or manual operations. Some examples include:

a. The use of traps, for example, light traps to capture insects in defined areas such as greenhouses.

b. Employing physical barriers such as screens, shelters, and electric and electronic devices.

c. Handpicking pests from the crop. Seed potato growers still remove diseased potato plants by handpicking. Insects can be handpicked or shaken from foliage on small acreages such as home gardens or on small trees. Fire blight of apples can be controlled by pruning the infected branch from the tree.

d. Manipulation or changing environmental conditions may eliminate some pests. The elimination of standing water by drainage and proper irrigation helps control mosquitoes. By manipulating temperature and humidity, pests in stored grains can be controlled. Proper drainage and correct irrigation helps eliminate the overwintering sites for the spores of downy mildew.

3. Biological Control Methods

Biological control involves the deliberate use of natural enemies for pest control. Parasites, predators or pathogens of a pest are either imported into an area of infestation or natural populations already present are stimulated and encouraged to become more efficient in preying on the pest. This method of control has been utilized for hundreds of years against a variety of pests, although the first successful attempt in the United States did not occur until 1887.

Biological control, or "biocontrol" is often very sophisticated in its requirements. Life history and habits of the pest and its natural enemies must be thoroughly researched well in advance of field testing. Success of the program depends upon the existence of an open niche for the predator or parasite in the environment of the pest, or a niche filled by a less efficient enemy. Successful introduction of a parasite, for instance, depends upon there being a position in the environment that it can inhabit. Once the natural enemy becomes established, and other problems do not occur to endanger its position, the biocontrol program has an excellent chance of succeeding.

In Montana, the use of an agent Rhinocyllus conicus is successful in reducing stands of Musk thistle (Carduus nutans). Collection of the insect by persons interested in controlling this weed has resulted in a wide distribution of the insect. Successful colonies of R. conicus are reducing stands of C. nutans by approximately 10% per year.

Other insects are being investigated for their ability to control many weed plants found in Montana.

4. Other Methods of Control

Other methods of control which do not readily fit into any of the above groups include the use of repellents, antimetabolites, and feeding deterents. Chemical attractants and sterilants, sterilization techniques utilizing mass rearing and release of sterilized males into the pest population are also feasible methods of pest control.

B. INTEGRATED PEST MANAGEMENT

Integrated pest management utilizes the best combination of methods to control a pest. Any combination of chemical, biological, cultural, or mechanical control can be employed. The key to IPM is maintaining pest numbers below an economic threshold, that pest population size that can be tolerated without incurring economic loss.

Successful IPM systems include:

1. Knowledge of pest's life history and environment,

2. Recognition of damage occurring at various population sizes,

3. Methods to monitor the presence of the pest,

4. Timing control methods to be most effective,

5. Chemical applications based on the economic threshold,

6. Development and use of selective pesticides, and

7. Integration of all feasible control methods.

Integrated pest management systems often eliminate unnecessary pesticide applications. This not only saves producer's money, but is environmentally desirable.

C. THE PESTICIDE APPLICATOR AS A PEST CONTROL SPECIALIST

The role of the pesticide applicator is rapidly changing. He must now become a pest control specialist, trained in all aspects of pest management and ecology. The profession requires more than the ability to operate spray equipment. Complete reliance upon pesticides as the only method of control must be abandoned. Switching from a single-faceted approach to pest control to a dynamic integrated system of pest management need not push the pesticide applicator out of business. On the contrary, by becoming a pest control specialist, he can not only expand his business, but also provide a more safe and effective service to his customers.

D. SELECTION OF CONTROL METHODS

1. Introduction

Once the need for pest control action has been demonstrated, the selection of the proper control method is necessary. No one particular method of pest control is correct for every situation. Pesticides are many times selected automatically without consideration to other control alternatives. Every problem, regardless of its location or type, must be thoroughly evaluated prior to selection of a control method. Every control alternative must be weighed equally. The method selected must be the one that causes the least disruption of the natural environment, insures the greatest safety to plants, animals, and humans, and provides an effective reduction in the pest numbers. Whenever feasible, a control method other than chemical pesticides should be selected. Economics of applications should not be the only selection criteria. If proper sanitation and/or the use of biological or cultural methods will give adequate pest reduction and their cost of application is not prohibitive, they should be utilized in the place of a less expensive chemical treatment.

2. Guidelines for Selection

Four general guidelines should be followed when selecting a method of pest control:

a. The target pest must be correctly identified. This may involve employing the services of a trained entomologist or taxonomist. Do not attempt to treat an unknown insect or disease. In many cases, treatment will be ineffective or hazardous to plants, animals, or humans.

b. Carefully examine the pest and the damage caused. Once the pest has been accurately identified, consult specially trained individuals, if necessary, to determine the possible existence of natural control agents that might be employed for control of the pest. Survey the crop damage to determine whether all or part of the crop is infested. Can the pest damage be sustained without significant loss in crop value?

c. The correct location of the pest is equally important, and will, in large part, determine the means of control. Insects are often quite mobile and may not remain in the damaged area for long periods of time. Accurately determining the site of their greatest activity will insure proper application of control methods. Fields, orchards, greenhouses, nurseries, livestock, barns, and public premises are examples of locations which require specific control measures.

d. Evaluate all possible means of control, i.e. cultural, biological, chemical, or mechanical to determine the most effective and safest method.

Chemical pesticides may be the most desirable method of controlling a pest outbreak. Correct selection and applications of the proper pesticide is essential for the effective chemical treatment of a pest. Be sure to consider all information available when selecting the correct pesticide for the job.